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FROM THE EDITOR

So where exactly is the “east”? And who made that decision?
I mean, if you go far enough in what we think of as an
“easterly”, direction, you surely end up in the west, right?

A little digging reveals that the word “east” comes from the Sanskrit “*usās*” which means “morning” or “dawn”. So while it really is relative (where the sun comes up depends entirely on where you’re standing), it looks like it was the ancient Indians that pipped everyone to the post in determining the cardinal points.

By the time those European colonial types took over and started throwing their weight around with all their map-making and the like, it was decided that all the colonies and countries to the east of India would be considered the “Far East”.

The phrase soon captured the public imagination and became synonymous with adventures in exotic faraway lands, and with the thrill of the unknown, unexplored, and untamed.

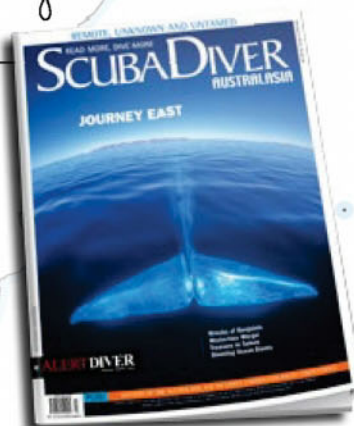
To those of us already living in the East, this place might not seem all that exotic. But the region is vast, and so, in this issue, we’ve gone off the beaten track, into some eastern extremes, looking for a bit of that old-school sense of adventure.

And we’ve found some of the kinds of thrills and spills in middle-of-nowhere places that could be worthy of the early explorers: From the little-known Burmese archipelago on South Asia’s eastern boundary, to the depths of Papua New Guinea, from hunting for glittering and undescribed critters in the waters off the most beautiful island in the Far East, to dives on the world’s largest aircraft graveyard in one of the most remote atolls in the Pacific.

We’ve gone so far east, we’re giving the
Wild West a run for its money!

Alice Grainger

Editor



ON THE COVER

Blue Whale Tail

The impressive seven-metre tail span of the largest animal ever to have lived on Earth.

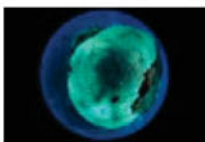
Image © Amos Nachoum

— We do know better... —

Big apologies to all our readers – in the last issue of *Scuba Diver AUSTRALASIA* we ran a highly erroneous piece of information. In the story *Body Matters*, SD5-2014, we stated that nitrogen makes up 21 percent of the air we breathe, and at one atmosphere has a partial pressure of 0.21. Now, as every self-respecting diver knows, these are the values for oxygen, not nitrogen.

I’d like to be able to blame the heinous error on years of teaching nitrox specialty courses, and hammering the partial pressure values of oxygen into student’s heads, or on some sort of permanent narcosis, but in the end the buck stops here and it really is a dreadful oversight. Sorry!

- Ed.



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CRITTERS OF THE EAST
By **William Tan**

A treasure trove of underwater jewels are waiting to be discovered in the waters off the Far East's most "beautiful island"

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CONSERVING A SHARK,
SUPPORTING AN ISLAND
By **Steve De Neef**
How thresher sharks are helping rebuild the economy in Malapascua after typhoon Haiyan, and, in the process, securing a future for other shark species



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JOURNEY EAST

THE MOST EXCITING PLACE
YOU'VE NEVER HEARD OF

By **Brandt Mueller**

Sunken WWII planes, sharks, ships that were once radioactive, thriving coral reefs, and hardly any other divers. Journey east to Kwajalein Atoll in the Marshall Islands, a place that really does put the "far" in "flung"

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For world-class diving adventures in the Pacific's eastern-most wilderness, look no further – get these places on your bucket list

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MARVELLOUS MERGUI
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SEAS OF THE UNEXPECTED

By **Michele Westmoorland**

Sharks and nudis and corals, oh my! Divers at Tufi in eastern Papua New Guinea are spoilt for choice



IN FOLIO

AMOS NACHOUM

The master of big animal photography tells the stories behind some of his most famous pictures, tales that are sure to have you ready to accompany him on his next big adventure.

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Find *Alert Diver* facing page 64, packed with essential information from the Divers Alert Network Asia-Pacific – the experts in dive safety, training and accident management



SHARKS KEEP US IN GRASS

If you like grass, you need to love your sharks. A new study has found evidence that sharks are vital in keeping seagrass meadows intact, checking the impact of munching turtles.

The study looked at seagrass communities in Bermuda, Australia, Indonesia and India; all places with large populations of green turtles. Green turtles are voracious grazers of seagrasses, but, in places with healthy shark populations, turtle numbers are kept in check, and seagrass meadows are able to flourish. But, with shark populations on the verge of collapse around the world, overgrazing (coupled with other environmental stressors) is causing the loss of seagrass meadows and their associated services.

Traditionally, most emphasis has been placed on coastal zone management in efforts to protect seagrass habitats, but the food chain factor has now been identified as an important component.

Considered to be some of the planet's most valuable ecosystems, seagrass meadows absorb carbon dioxide at twice the rate of tropical forests, provide nurseries for many marine species (including vital

commercial species), mitigate coastal erosion, and promote healthy coral reefs by protecting water quality and reducing turbidity.

James Fourqurean, co-author of the study, was quoted on *Mongabay.com*, saying, "Historical overfishing of sea turtles so drastically

reduced the numbers of turtles in the ocean that impacts on seagrass meadows were rarely recognised. It's only now that conservation efforts are on their way to restoring sea turtle populations that we are now experiencing the consequences of how overfishing large sharks is impacting seagrass."

Image © P. Lingren courtesy of Wiki Commons



COMIC CORNER

"That's the last time I let **YOU** organise a PADI dive trip!"



FISH TO THE POLES

Climate change is likely to be causing a gradual exodus of fish from the tropics to the poles, according to a study by the University of British Columbia.

Temperature increases from one to three degrees Celsius by 2100 would cause fish to move from 15 to 26 kilometres respectively per decade away from their current habitats towards cooler waters, predictions that are consistent with the movements of fish and invertebrates witnessed in the last few decades.

These shifts will have serious impacts on the fisheries of the future, with new opportunities for fisheries in the Arctic and Antarctic, and equatorial seas losing out.

DIVING INTO THE FUTURE

A material recently developed by a team at the University of Southern

FACTS AND FIGURES

There are more than

25,000 islands in the Pacific

Around

70% of the oxygen on Earth is produced by marine plants

Some healthy tropical coral reefs can host up to

1,000 species per m²

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WORDS OF WISDOM

“There’s nothing wrong with enjoying looking at the surface of the ocean itself, except that when you finally see what goes on underwater, you realise that you’ve been missing the whole point of the ocean. Staying on the surface all the time is like going to the circus and staring at the outside of the tent.”

~ Dave Barry

“Every time you dive, you hope you’ll see something new – some new species. Sometimes the ocean gives you a gift, sometimes it doesn’t.”

~ James Cameron

“Sponges grow in the ocean. That just kills me. I wonder how much deeper the ocean would be if that didn’t happen.”

~ Steven Wright

“He who travels far will often see things far removed from what he believed was Truth.”

~ Hermann Hesse, *The Journey to the East: A Novel*

Denmark could be a step towards revolutionising the way we dive.

Small quantities of this newly synthesised crystalline compound are capable of absorbing huge amounts of oxygen from the air and from water, and releasing it, much like a sponge. The substance is being compared with haemoglobin – the protein in the blood of all mammals that carries oxygen around the body.

There are plenty of exciting potential applications for this extraordinary substance, but none more so than the idea that one day we might only need to take a few grains of it with us underwater for dives almost unlimited by the amount of air in a tank.

Of course, as divers we know that before this could ever become a reality, a system would need to be developed that could combine any oxygen provided by these crystalline grains with nitrogen or another inert gas to prevent the toxicity associated with breathing oxygen under pressure. Still,

this is an intriguing glimpse into one potential future of scuba diving.

LINGUA-ORCA

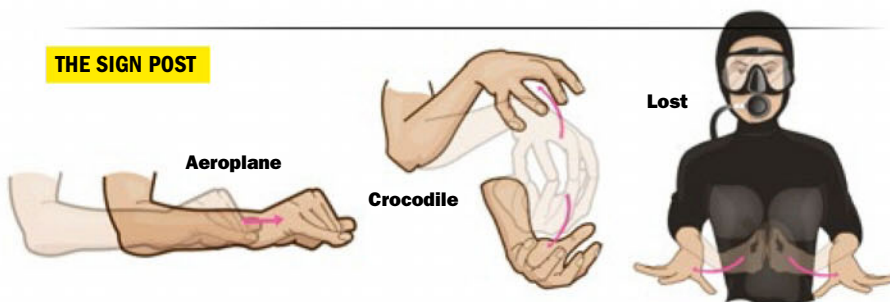
As if we needed further proof of the advanced intelligence of our cetacean brethren, orcas have now joined the select ranks of creatures that are known to be able to learn foreign languages.

Researchers analysed the vocalisations of orcas that had been kept with other orcas and compared them with those that had been held in close proximity to dolphins. The

whales that had been kept with dolphins were found to be using dolphin-like clicks and whistles, rather than the whale pulses more typical of the other group.

Perhaps the result of this study, published in the *Acoustical Society of America*, will help bolster the case against keeping these highly developed creatures in captivity. [SDAA](#)

THE SIGN POST



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OCEAN WATCH

By Steve De Neef

CONSERVING A SHARK, SUPPORTING AN ISLAND

In the devastating wake of a super typhoon, one elusive species of shark is securing the recovery of an island in the Philippines

About a year ago a whole nation was stunned after experiencing the strongest typhoon to ever make landfall. Super Typhoon Haiyan, or Yolanda as the locals called her, passed over the Philippines on November 8, 2013. Its path of destruction left thousands dead and millions homeless, changing lives forever.

Since then, many of those affected have been struggling to resume their lives and continue their livelihoods. Over the past year the support from the rest of the world has been enormous, but even with all this help, it has been very hard for people and economies in the Philippines to recover.



1. The elusive pelagic thresher shark, *Alopias pelagicus*, is rarely encountered elsewhere

2. Rising from the rubble: Homes and businesses are being rapidly rebuilt thanks to ecotourism generated by the threshers of Monad Shoal

RESILIENCE FROM MONAD SHOAL

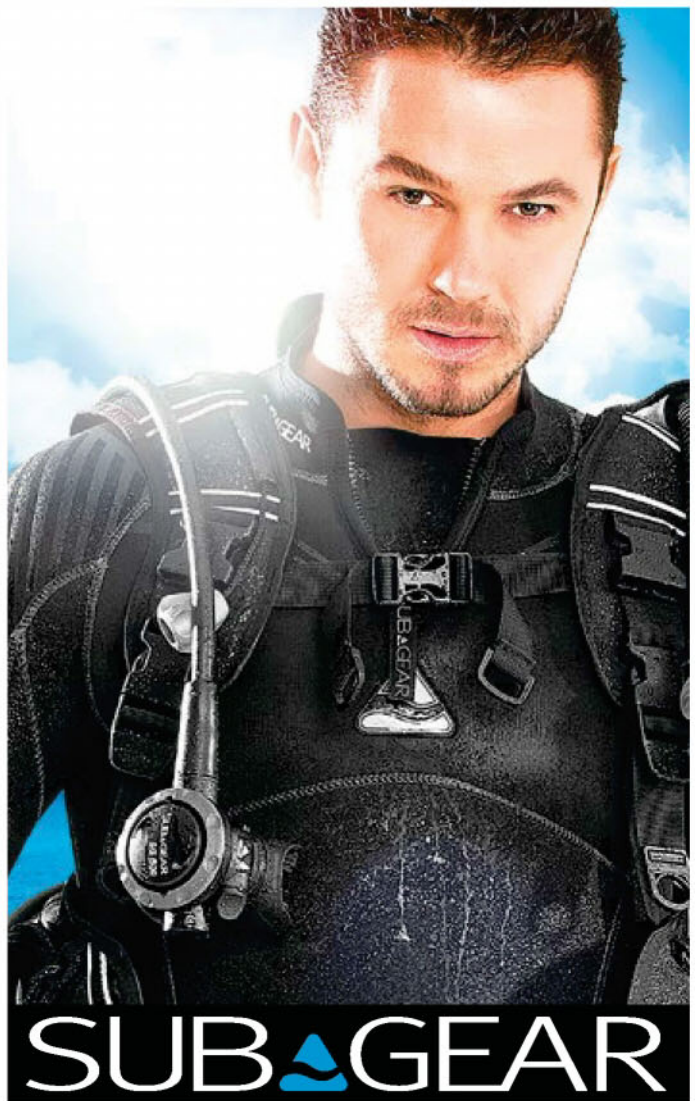
One place that did manage to rebuild quickly is Malapascua Island, even though most houses and boats were reduced to rubble after the super typhoon passed. Just one year later many locals have managed to pick up their lives and thrive once again. Part of the reason for this rapid recovery can be found in an unusual place just nine kilometres offshore, at a submerged seamount called Monad Shoal.

Monad Shoal is a place like no other. Every morning at dusk, pelagic thresher sharks (*Alopias pelagicus*) come up to the shallower parts of this shoal. Divers from all over the world visit this place in the hope of seeing these graceful sharks with their distinct scythe-like tails. These nocturnal oceanic sharks come here for one reason only, to be cleaned by cleaner fish like the cleaner and moon wrasses (*Labriodes dimidiatus* and *Thalassoma lunare*) that inhabit the multiple cleaning stations found at Monad Shoal. Nowhere else in the world can you reliably see thresher sharks on a daily basis and observe them up close. It's exactly this phenomenon that makes Malapascua famous, and eco-tourism based around these sharks has played a major role in the island's recovery.

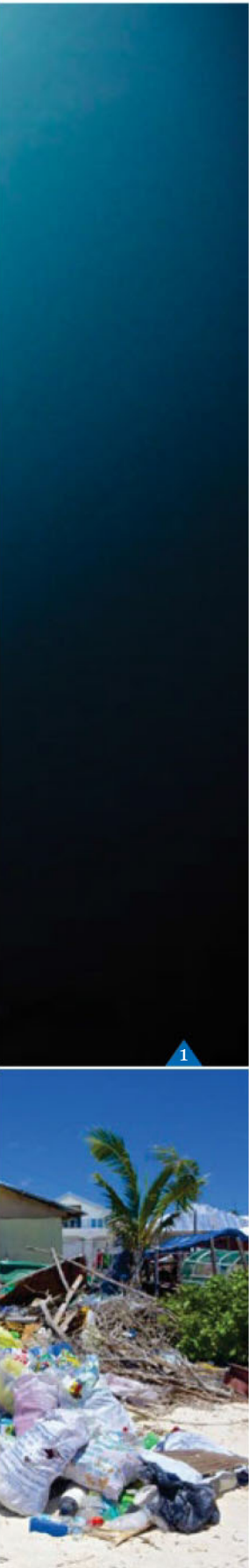
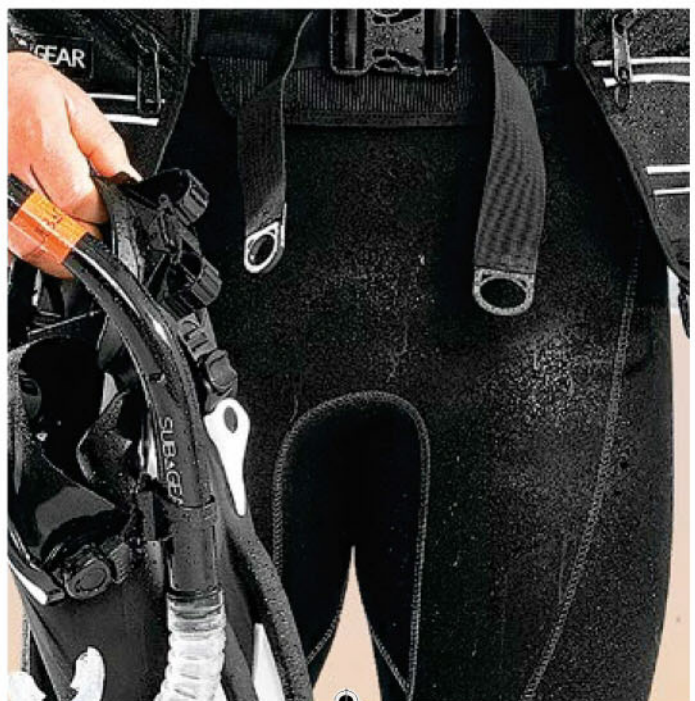
A few days after Typhoon Haiyan, Malapascua had already received huge support from the local dive industry and tourists who were in love with the island. One year later almost everyone has managed to rebuild their homes and livelihoods. Some locals even say they have better homes now than they did before the typhoon. Tourists are still coming to see the pelagic thresher sharks, which, considering that 80 percent of income on Malapascua is directly related to this industry, means that Malapascua's economy is stable.

THRESHERS UNDER PRESSURE

In 2002 Monad Shoal was declared as a marine reserve. While this was a step in the right direction, it hasn't been able to stop illegal fishing – even today Monad Shoal still falls victim to destructive methods like dynamite and



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longline fishing. The income derived from tourism and the associated marine park fees don't trickle down to all the fishermen who use these places. Furthermore, in the Philippines thresher sharks are still directly targeted and caught as by-catch on a regular basis. It's sad that within the same country these sharks are both adored and killed. Currently thresher sharks are not a protected species in the Philippines.

According to the Thresher Shark Research and Conservation project, the value of one live thresher shark per day at Monad Shoal can be in excess of USD 135,000 per year. This same shark at a local fish market would only sell for USD 180. The meat sells for two to three and a half US dollars a kilo while the fins can go for as much as USD 22 per kilo, still only a fraction of what the sharks are worth alive.

Currently all three species of thresher sharks (bigeye, common and pelagic) are listed as "Vulnerable" according to IUCN's Red List. This means if no active measures are taken to protect them, considering that they are one of the global shark fisheries' most in-demand species, their status will quickly deteriorate to "Endangered" or worse. As these sharks are pelagic in nature, protecting them in just one place like Monad Shoal is a good start but won't do much in the long run since they can still be caught while travelling out of protected waters. To make sure thresher sharks (and tourism in places like Malapascua) survive, broader protection is necessary. All thresher sharks are prone to unsustainable fisheries and by-catch, and with their low fecundity (two to four pups per litter) and long gestation period, their



3. Sustainable thresher-based tourism is proving that sharks are worth vastly more alive than dead

4. A community mobilised: With threshers still on the IUCN Red, community-driven conservation and enforcement is key to ensuring their survival

populations can decline quickly. In most places thresher shark populations are already down by more than 75 percent when compared to the 1980s.

ONE FOR ALL

It does seem like things are moving in the right direction in the Philippines. People are slowly becoming aware of the fact that sharks are essential in maintaining healthy ocean ecosystems and are worth more alive than dead.

Since September 2014 the province of Cebu amended an ordinance that protects various marine resources to now include the protection of all shark species. While this is only applicable in one province, it's certainly an encouraging sign.

Enabling fishermen to tap into the shark tourism economy will be the real challenge, as, without an alternative income, it's hard to stop people from fishing when they rely on it for their livelihoods. It is possible though – in Malapascua many of the boatmen and even dive guides used to be fishermen. Tourism on the island is going strong, the sharks' popularity is still growing and the associated industry is providing ever more jobs. Shark tourism has proven to be a viable conservation tool and a profitable business.

Researchers from the University of British Columbia published a paper in 2013 that estimates global shark ecotourism brings in USD 314 million annually and is expected to more than double in the next 20 years. If this is the case then it would exceed the current profit made by shark fisheries.

Monad Shoal serves as a great example for shark tourism and has proven to be invaluable in ways no one could have foreseen. Hopefully this success will continue to inspire people and governments to protect rather than exploit this important species, so that for many generations to come people can enjoy the magic of encountering one underwater. [SDAA](#)

This article was made possible with the help of the Shark Foundation www.shark.ch



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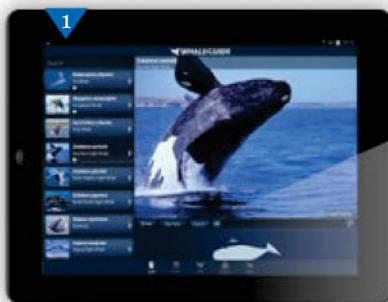
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XTRAORDINARY DIVES

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By **Michael Werberger**

The blue sharks were all around us, relaxed, curious; it seemed like the perfect time to photograph the group. I freed myself from the rope and dived a little deeper.

A moment later, one of the sharks swam directly over to me. I was so enthralled that I almost forgot to pull the trigger. Looking him in the eye, I was overcome by this eerie feeling that always hits me when I dive with blues – that I know I will never see this same animal again.





Santa Clara

MAHON HARBOUR,
MENORCA,

BALEARIC ISLANDS

By **Sergi Garcia**

It's not an easy dive – the wreck is deep and there is heavy boat traffic on the surface. But on this day there were also big waves and poor visibility and before we dropped in we were all feeling the nerves. But, once we started

down the descent line, the feeling changed, as the boat appeared out of the gloom like a phantasmagorical mystery.

She seems almost alive, ready to sail the depths of the Mediterranean at any moment. I don't know if it was the minor hit of narcosis, but as I started back up to my safety stop, I wondered if next time I would get to meet the crew...



Hidden Gems

KUDA GIRI, SOUTH MALE
ATOLL, MALDIVES

By **Christian Llewellyn**

I love exploring all the areas where marine life shelter on wrecks. While on an unknown wreck at Kuda Giri in the Maldives I found these soldierfish in the bridge. The amazing contrast of the deep red and dark negative space truly made them look like hidden gems.

TAIWAN

CRITTERS OF THE EAST

By William Tan

When the 16th-century Portuguese sailors sailed past Taiwan, they exclaimed, “Ilha Formosa!” or, “Beautiful island!” Little did they know that the most alluring part of Taiwan actually lay underwater, right beneath their ships.

In the summer of 2014, Ben Sarinda and I were invited to Taiwan by Fun-in Underwater Photographic Equipment Co. Ltd. on a recce trip for a possible future return with Ned and Anna DeLoach. We were fortunate to be able to dive the northeast coast, Green Island and Kenting.

The local Taiwanese divers are a tough lot. Diving here is an intrepid activity, and normally involves staying at a local home-stay, driving your own gear and rented tanks to your site of choice, climbing down a small cliff, and walking through tricky rocks or dead corals into the water. Nevertheless, boat dives and other added services are indeed available in Taiwan too – they just come with hefty additional charges.

NORTHEAST COAST

At dive site 82.5, we followed our Taiwanese friends down a simple stainless steel ladder and walked through big boulders before we reached a seaweed-covered bay. But, just a short swim out and we were in nudibranch paradise! Searching the muck revealed nudibranchs of many different genera, including *Ceratosoma*, *Cuthona*, *Dermatobranchus*, *Gymnodoris*, and *Trapania*.

1. Shrimp, *Alcyonohippolyte dossena*, in soft coral

2. An as yet undescribed species of Janolus, *Janolus* sp.

3. Red colour variation of the nudibranch *Favorinus tsuruganus*

4. Dwarf sea hare, *Aplysia parvula*

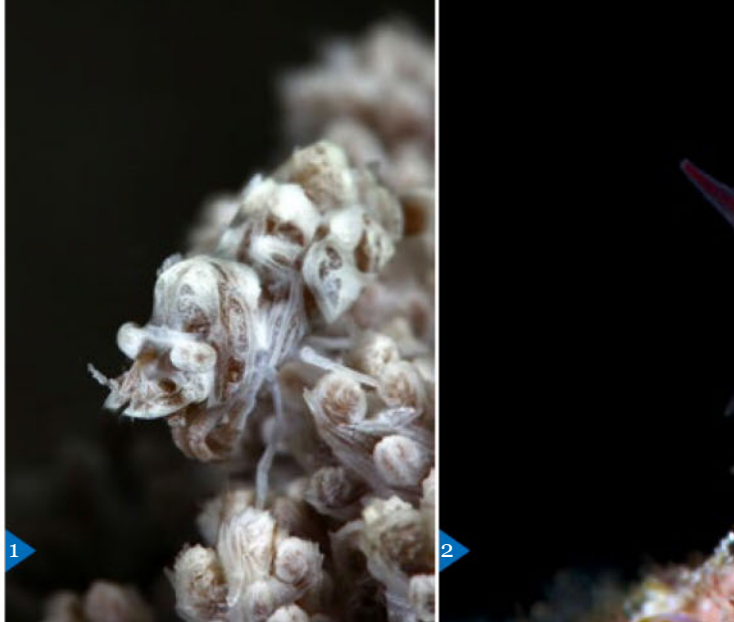
5. Unidentified species of shrimp with eggs

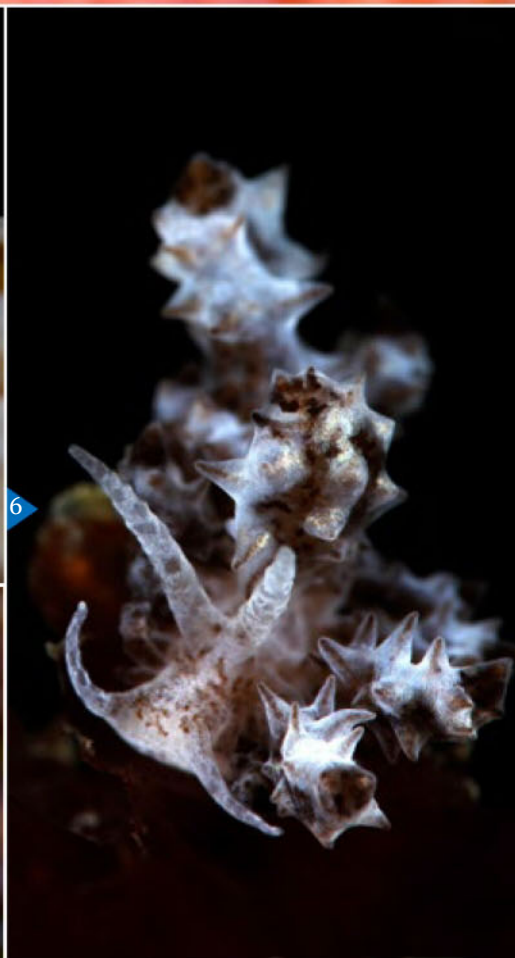
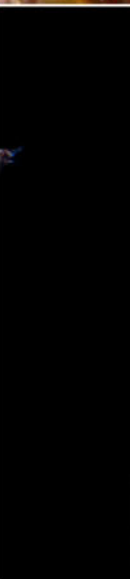
6. Juvenile *Phyllodesmium koehleri* with

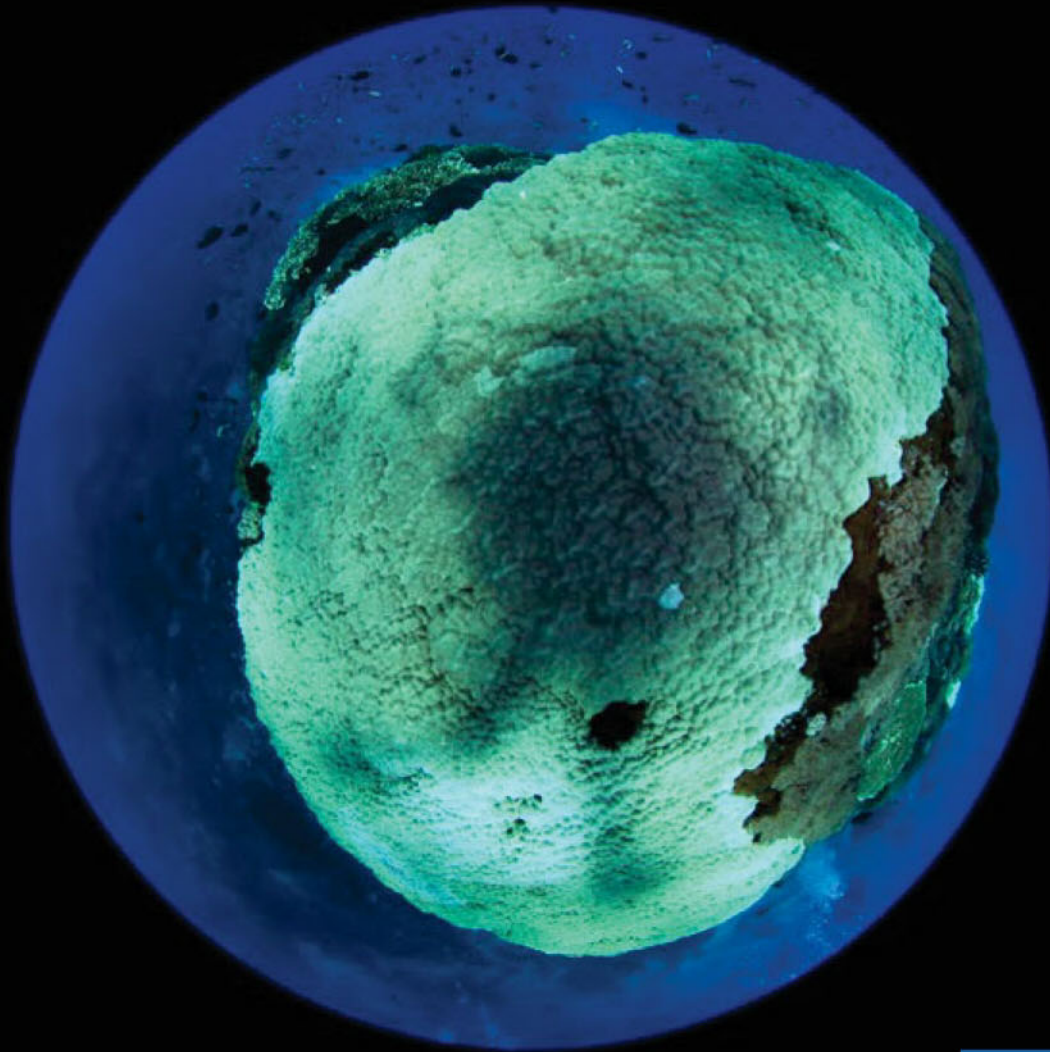
7. High-hat triplefin, *Enneapterygius tutuilae*

8. Undescribed goby, *Trimmatom* sp.

9. Unidentified crab in jellyfish







10. The ancient *Porites* bommie at The Big Mushroom, Green Island

was also shown a *Doto* species that is common here, but still undescribed by science.

Just as intriguing were commensal crabs that played hide-and-seek in their large jellyfish host that drifted by, and a resident blenny that gave a super star-quality jack-in-the-box performance in front of my camera.

Our good friend Perry Guo offered us his boat to dive Secret Garden, a site that is challenging and potentially dangerous to access from the shore. Although the water can reach a comfortable 26 degrees Celsius on the northeast coast in the summer, we were shocked to see our computers reading only 19 during this dive!

But we were off to Green Island and Kenting, which, lying in the path of the warmer “Black Tide”, offer quite different diving experiences.

GREEN ISLAND

Green Island’s most famous dive site, The Big Mushroom, is marked by an immense *Porites* bommie of more than 1,000 years old. Even though it was an overcast day and the seas were choppy, we still enjoyed an incredible 50 metres of visibility underwater!

Our dive operator Vincent Yu of Airfish Diving Center not only knew all the critters by their Latin names, but had also undertaken many exploratory dives on the island. Ask him about anything on your wish list, and he will know where on the island it can be found. Coral spawning? No problem: Vincent has the spawning dates of each coral species at his fingertips too!

For more nudibranchs, Vincent took us to Blue Hole, followed by a night dive at Hot Spring Harbour. It was nudibranch galore at both places! Of the many beautiful nudibranchs we saw, quite a number were still undescribed.

Most of the dive sites on Green Island are accessible from the shore, and most are home to three species of pygmy seahorses: *Hippocampus pontohi*, *H. severnsi*, and *H. colemani*. *H. colemani* was first spotted in the summer of 2007, and by the famous actress Qian-Lian Wu. A recent study by experts at Kenting’s National Museum of Marine Biology and Aquarium also revealed that this might well be a totally different species from the Australian variety that we are familiar with.

KENTING

At Kenting, we stayed at the beautiful Macro Villa and dived with Penny Liang, a spirited young researcher at the National Museum of Marine Biology and Aquarium who specialises in crustaceans.

Eagle-eyed Penny showed us many shrimps and crabs underwater, some I was seeing for the very first time.

During a dive at He Jie, Penny suddenly came over to pull me away from a nudibranch I was trying to shoot. She led me to the deeper, sandy bottom, and showed me a teddy bear crab! This is a crab that should appear on the wish list of every respectable underwater photographer. Having shot this crab before, both in Manado and Gorontalo, I decided to let the other photographers have a go at it first. Big mistake! By the time I got to the crab again, I was already down to my last minutes of bottom time. Fortunately, the crab was cooperative, and the shoot was quick and rewarding.

I must also thank Taiwan's nudibranch expert Sung-Hung Wu, for showing me the sites where he did all his studies. But, as Murphy's Law would have it, when Wu found a special nudibranch he himself had never seen before, I was nowhere to be found!

A return trip to Taiwan with Ned and Anna Deloach is a must. There are simply too many critters here for a single trip. *SDAA*



11. Red breasted wrasse, *Cheilinus fasciatus*

William Tan has been fascinated with the creatures of the sea since childhood. While studying at the Johns Hopkins University, USA, much of his spare time was spent gazing at the extensive marine collection of the National Aquarium in Baltimore. A violinist with the Singapore Symphony Orchestra, William earned his scuba diving certification in 1994. Since then, without his prized antique Italian violin, he has travelled extensively between concert seasons throughout the Pacific region judging underwater photo competitions, and photographing marine life for tourism organisations, scientific research groups, dive magazines, camera manufacturers, and resorts.

NAVIGATOR

Getting there:

Many airlines have regular international flights into Taiwan with airlines such as Cathay Pacific, Jetstar, Garuda, United, and Singapore Airlines.

Once in Taipei:

Northeast Coast: Best to drive. You will need the car to transport your rented tanks and gear to the dive sites.

Green Island: Take a train from Taipei to TaiDong. Taxis from train station will bring you to TaiDong's FuGang harbor, where you can catch an one-hour ferry to Green Island. There are also three 20-minute flights a day from TaiDong Airport to Green Island's small airport.

Kenting: From Kaohsiung, there are buses to Kenting from Zuoying High Speed Rail Station, Kaohsiung airport, and the train station. At the train station, there are also shared taxis and minivans bound for Kenting.

Best time to dive:

Year round in Green Island and Kenting, but summer is the best time to dive the northeast coast.

Essential training:

Open water and up.

For more information:

Note that on Green Island only the larger hotels on the island accept credit cards. A single ATM machine at the Post Office across the street from 7-Eleven, doesn't take foreign bank cards, so be sure to bring plenty of cash. Visit www.immigration.gov.tw.



PAPUA NEW GUINEA

SEAS OF THE UNEXPECTED

By Michele Westmoorland



1. Fingers of jungled land stretch into the sea, becoming richly inhabited reefs

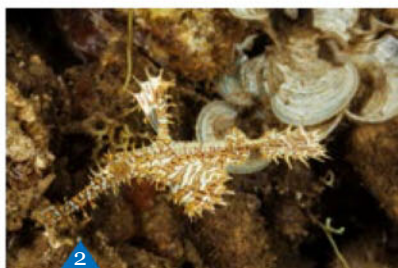
Land and seascapes that put the “wild” in wilderness; diving in eastern Papua New Guinea is about being immersed in mystique, and surrounded by all creatures great and small.

As you approach from the air, clouds drape over the spine of the Owen Stanley Mountain Range, obscuring bits and pieces of the lush forests. Green fingers of land stretch out into the alluring waters of the Solomon Sea. Suddenly, there on a bluff is the beautiful Tufi Resort. The short flight is only one hour from the capital, Port Moresby, but the landscape could not feel further removed. Landing among this backdrop gets the excitement flowing for all the spectacular diving to come.

I have been to Papua New Guinea almost 30 times and never tire of the adventures that await me. In addition to the diving, the chance to see my *wantoks* (friends) in the surrounding villages makes visiting this location all the more special. Those who choose to come to Tufi for the very first time will discover experiences that will remain in their memory forever. The cultural interactions are rich, the landscape is breathtaking, and the marine life is incredibly diverse. Divers here are spoilt for choice.

A calm Solomon Sea allows access to the outer reefs where

pelagic creatures play. Sharks cruise the dive sites and for lucky divers, a rare white hammerhead occasionally appears. The Tufi area is also so full of unexplored wrecks and reefs that it is one of the few places where new discoveries and first dives (maybe with your name on it) can be made. For now, here is just a taste of some of the highlights of Tufi's diving...



The **HOUSE REEF** rivals some of the best muck diving in the world: mandarinfish in the rubble, and, below the dock, ghost pipefish, crabs, shrimp, nudibranchs and numerous other strange little creatures. Along the wall and away from the “muck”, an unusually marked species of percula clownfish can be found. The site is also a baby cuttlefish nursery, and these mini cephalopods can be spotted hiding amongst the corals.

2. Ornate ghost pipefish, *Solenostomus paradoxus*

3. A pair of mandarinfish, *Synchiropus splendidus*, members of the dragonet family



CYCLONE REEF is actually a small island that was formed from broken coral. As the name suggests, it was formed during a cyclone that hit the area in 1972. Today, it is a breeding ground for a variety of seabirds and a great mooring spot for a dive boat. The area has three distinct dive locations: Cyclone Bommie, Cyclone Wall and Cyclone Reef Outer Wall. Walls, overhangs and swim-throughs harbour everything from rare rhinopias to schooling fish. If you are willing to take your eye away from the blue and the chance of seeing pelagics passing by, scores of nudibranch species and other tiny creatures can be found in the cracks and crevices.

4. A thriving garden of scroll coral, *Turbinaria reiniformis*



Only discovered about a year ago, **HONEYMOON REEF** was one of the more memorable dives I have made. It started at the wall and I was initially unimpressed until we got a bit shallower. An incredible field of cabbage coral appeared in absolute splendour. Mixed into the healthy expanse were plenty of Acropora corals, clams and brilliant orange anemones with large spine-cheek clownfish interspersed. The beauty of Honeymoon Reef is unmatched. It makes me wonder about new reefs that will be discovered nearby in the future and fuels my desire to return to Tufi once again.

5. Spine-cheeked anemone fish, *Premnas biaculeatus*



6. A silver tip shark, *Carcharhinus albimarginatus*, cruising the reefs

8. Juvenile cuttlefish can be found amongst the rubble at Tufi's House Reef

9. Villagers in traditional dress rowing a traditional outrigger canoe up the McClaren Harbour Fjord

MULLOWAY'S REEF is the resort's most famous. At depth, we experienced not only great numbers of batfish and barracuda but also a ball of brilliant red bigeyes. This was a photo I could not leave without.

Some of the best visibility in the area comes from the upwelling ocean current. It brings bountiful food for the thousands of fish, which, in turn, draw in the predators. Time was short at 33 metres but we managed to catch a glimpse of the great hammerhead that frequently cruises the wall.

7. Schooling big eyes, *Priacanthus hamrur*



There are historic wrecks too of course, the most famous being **BLACK JACK BOMBER**. It is for skilled divers only and although I personally have the credentials and number of dives to consider it, it still remains on my diving bucket list.

When the weather is wet and the wind is blowing, I've also found diving the shallow reefs in the **FJORD AREAS** to be fascinating. The fjords are excellent for macro diving with gobies, nudibranchs, shrimp and clams. These animals can be seen while diving, but conditions are also ideal for snorkelling. Because there is very little current movement in the fjords, many sponges and coral species grow prolifically and there are some very large sponges and shelf corals that are not common on the outer reefs.



IMMERSED IN A TIMELESS CULTURE

I truly believe you cannot go to Tufi without learning about the people and culture. It can be experienced from the resort or you can choose to spend a day or so in one of the village guesthouses. For those who want a more hardcore adventure experience, try a trek on the Kokoda Trail. This is not for the faint of heart and training is necessary to complete it. Kokoda has significant World War II history and is deeply cherished by the Australian community. Anyone who completes it may walk away exhausted from the journey but with a sense of pride in completing the trek.

Immersing yourself in the culture begins with a trip up one of the peaceful fjords on a traditional outrigger canoe. Birds swoop overhead, alerting the forest to a human presence. Traditionally dressed villagers greet the boat with smiles full of pride. They are truly happy to share their lifestyle with others. From learning how they prepare their staple food, sago, to how and why the women tattoo their faces, visitors begin to understand just how connected the people are to the land – and the nearby ocean.

Tufi Dive Resort is, without a doubt, a treasure in the “Land of the Unexpected”. The charming lodge and bungalows provide excellent service, accommodations and food. The dive masters are among the best and can guide you to some of the most unique species of marine life from the comfortable dive boats. If there is any must-see for a diving enthusiast, this is it. [SDAA](#)

Michele Westmoorland is a freelance photographer from the United States. She has created a vast library of images from around the world over her 25-year career. A proud Senior Fellow of the International League of Conservation Photographers, Michele was also inducted into the Women Divers Hall of Fame in 2011. Much of her imagery has appeared in national and international publications. Her book *Ocean Duets* was published in 2006. In addition to underwater photography, Michele is known for her work capturing the diverse cultures of Melanesia. www.westmoorlandimages.com



PAPUA NEW GUINEA

NEW BRITAIN

PORT MORESBY

GOODENOUGH ISLAND

FERGUSON ISLAND

NORMANBY ISLAND

NAVIGATOR

Getting there:

You can fly into Port Moresby with Air Niugini, Virgin Australia and Qantas. Flights leave Port Moresby three times a week. Tufi Resort can book these for you at great rates.

Best time to dive:

Late October to May, when the average water temperature is 29-31 Celsius and the visibility is 40 to 50 metres.

Equipment and training:

An open water certification.

For more information:

Tourist visa on arrival is an option for most nationalities. Check with your local embassy or visit www.immigration.gov.pg/visa/visa-all.html.

MYANMAR

MARVELLOUS MERGUI

By Thomas Ozanne

Dramatic topography, chance encounters with mantas and whale sharks, unexplored dive sites with nary another boat in sight; at South Asia's eastern edge, Burma's Mergui Archipelago is the Andaman Sea's best-kept secret. Until now.

It's as accessible as the diving in Thailand but home to a much healthier and greater biodiversity of corals, crustaceans, nudibranchs and fish, yet only a handful of liveaboards explore the diving on offer in Myanmar. This meant that on our trip, we didn't see any other divers underwater, or even another dive boat for all five days we were there. I haven't found many places within such easy reach that make it possible to get away from the crowds and experience a genuine feeling of adventure – exploring rarely dived and unspoiled sites.

Limestone geology means dive sites are covered in healthy corals and riddled with caverns and dramatic swim-throughs. Add to this seasonal mantas and whale sharks and you have a recipe for exciting dives and impressive wide-angle photo opportunities. My camera's lust for interesting macro subjects was also satisfied: harlequin shrimps, frogfish and even regionally-rare waspfish and velvetfish. A large variety of nudibranchs, rare sponge snails, bubble shells, as well as pipefish and Pegasus seamoths came out to play as well.

Welcome to the marvellous Mergui.

1. Painted sweetlips, *Diagramma pictum*, stream over the dazzling living substrate at Candy Corner





WESTERN ROCKY ISLAND, CRAYFISH CAVE

Descending on the southwestern corner of the main rock, we were led to a mighty arch at 20 to 22 metres. Swimming around and then back through the arch gave some impressive views and great wide-

angle photo opportunities. A school of fusiliers and a school of juvenile yellow tail barracuda were hanging out beyond the arch and a small school of yellow snapper was lurking just inside. Heading east we came to the mouth of a large cave with an impressively high ceiling and a

floor made up of thousands of fallen clamshells. It's dark in there, and I was glad of my torch. Two faint glows mark the exit. I took the exit to the right – the other is too small to pass through – and on the way out, spotted three painted crayfish lobsters on the wall of the cave – a crayfish cave, indeed!

On the way up to the boat, I found a couple of pairs of harlequin shrimp enjoying their starfish dinner.

Each time we dived this site we were treated to something special – eagle rays, oceanic mantas and, on one dive, a glimpse of a whale shark!



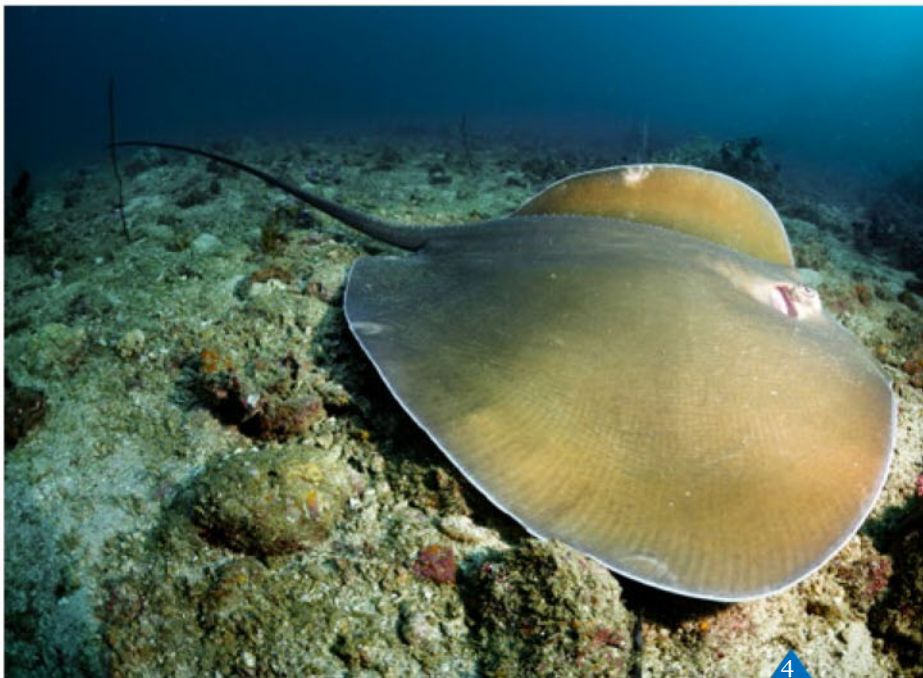
2. A cuttlefish, *Sepia* sp., hovers by the entrance to Crayfish Cave

3. Mergui's topography, both above and below the waves, is dramatic and imposing

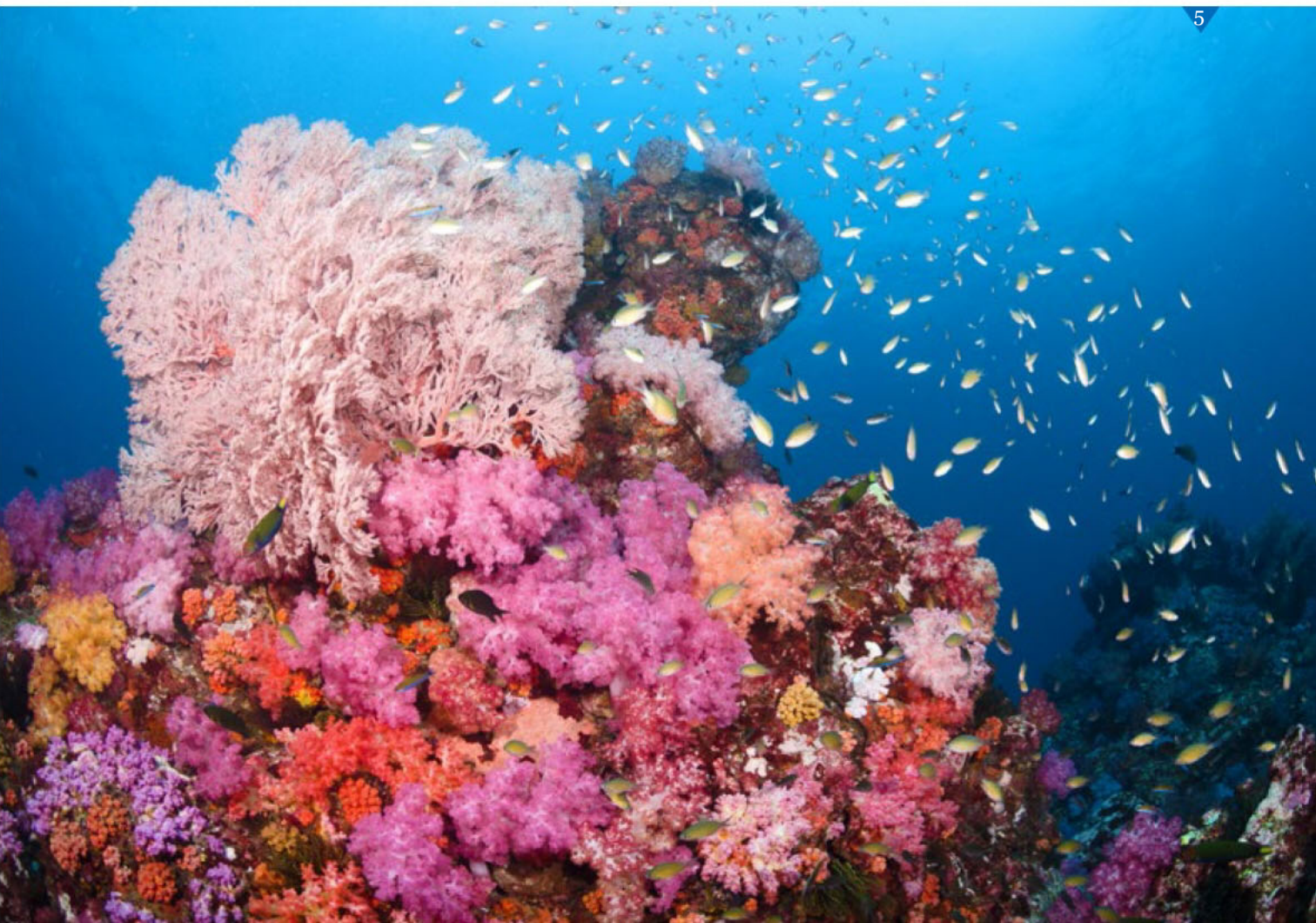
THREE ISLETS, IN THROUGH THE OUT DOOR

This is a wonderfully moody dive that gets its name from its structure: It is an impressive canyon leading to two adventurous swim-throughs that allow you to pass from one side of a small islet to the other.

Descending on the northwest corner of the middle islet, we followed the wall on our right. This led us to a narrowing canyon. There was swell on the surface, channelled by the canyon; timing our breathing and finning, we rode the surge all the way through. The wall becomes an overhang and in the shade, yellow sponges cover the rocky bottom. There is a large swim-through made by a boulder resting up against the wall. A couple of huge marble rays



4



5

were resting on the bottom. They were impressively big.

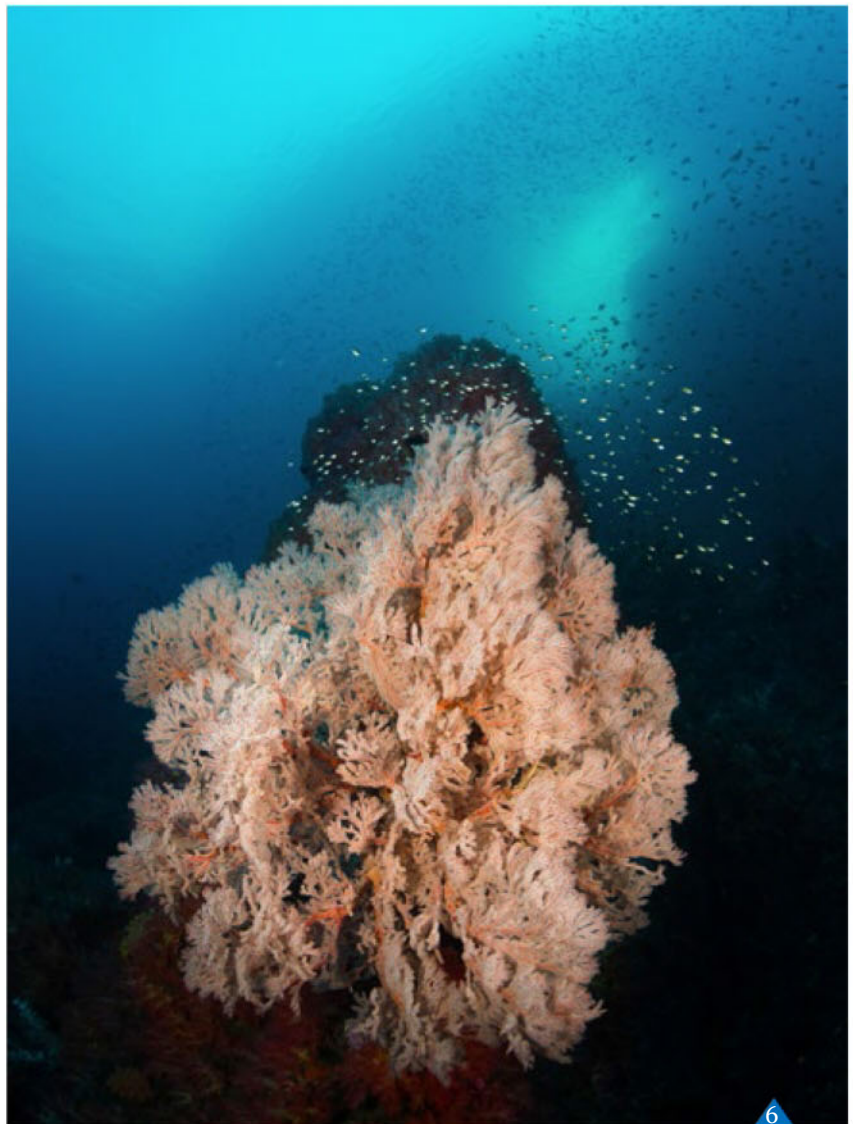
We exited the canyon by passing through a large, narrow cavern that opens up on the eastern side of the island. Heading north we spotted a nurse shark sleeping between the boulders. The dive kept on treating us to interesting encounters: We found groups of large lionfish hunting and too many bearded scorpionfish to count, a couple of false stonefish and moray eels. In the shallows, the corals were healthy and abundant.

4. A stingray, *Dasyatis* sp., hugs the sea floor in search of prey

CANDY CANYON

This was one of the most beautiful dive sites I have seen on this side of the Malay Peninsula. So much colour! The site is almost entirely pink, yellow and orange, covered by an incredible blanket of soft tree and broccoli corals as well as fan, whip, and harp corals. Anything that isn't covered in soft corals is covered in pink and yellow *Tubastraea* corals and feather stars. It's a beautiful backdrop to the clouds of basslets and fusiliers sheltering and feeding here. We came across a small group of sweetlips seeking shelter amongst the fans, and, on the channel floor, we found multiple bent stick pipefish and a handful of nice nudibranchs. An incredibly memorable and photogenic dive.

5. Soft corals are a riot of colour at the aptly named Candy Canyon



ELEPHANTS KISS

At just after seven in the morning, we dropped in on the western side of the island, right next to a massive, imposing arch, through which the rising sun was blazing – perfectly framed. What a way to start a dive! We descended towards the boulder-covered slope running down to the sand at about 25 metres.

As we hit the bottom, out of nowhere, we were buzzed by large schools of beefy jacks and rainbow runners, taking us completely by surprise. They disappeared into the blue just as quickly and unexpectedly as they had appeared. As we headed along the edge of the reef, we came across a large Jenkins whip ray,

resting on the substrate. Moving up to 18 metres or so, we entered a swim-through that opened out into a large bowl on the opposite side of the island. The site is criss-crossed by these dramatic fissures, which means lots of things of interest to see, and a whole variety of ways to dive it. Continuing south we took a second swim-through back out to the western side, and finished our dive in the shallows.

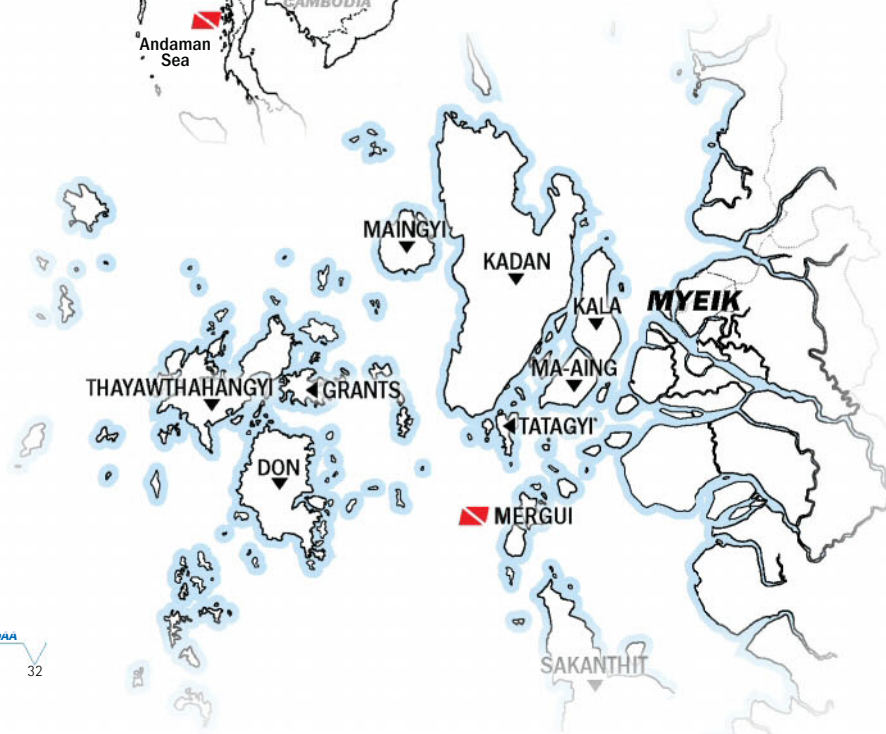
6. Corals thrive in the nutrient-rich waters at the labyrinthine Elephant's Kiss

BLACK ROCK

If fortune favours, this site can bring world-class encounters with oceanic mantas and maybe even whale sharks. If the big boys and girls don't show, there is a resident school of eagle rays and a few shy whitetip reef sharks to seek out, as well as an impressive colony of anemones and frequent gatherings of mating cuttlefish. The visibility and water temperature can be unpredictable here, from five to 30 metres and anywhere between 24 and 29 degrees. Wrap up warm!

With this just a small selection of the dramatic diving on offer in the marvellous Mergui Archipelago, Myanmar is sure to be the next big destination on everyone's bucket list. [SDAA](#)

7. At Black Rock, as with most sites in Mergui, there are good chances of seeing manta rays



NAVIGATOR

Getting there:

Trips depart Khaolak in southwest Thailand. The best option is to fly international direct to Phuket and grab a taxi to Khaolak. You can also go through Bangkok and onwards to Phuket via a short and reasonably cheap domestic flight; Bangkok Airways, Thai AirAsia and One-to-Go offer multiple daily flights. VIP night buses depart from Bangkok every evening if you have the time and want to save some money. If you are in Myanmar, you can take Yangon Air or Air KBZ from Yangon to Kawthaung (with two stops) and spend one night at a hotel before meeting the boat at the pier.

Best time to dive:

The season runs from November to April. Water temperature and visibility varies from site to site throughout the season, fluctuating between 24°C and 29°C and from 10 to 30 metres.

Essential training:

An Advanced Open Water certification to enjoy the more challenging dives, and Nitrox certification for extended bottom times and more conservative nitrogen exposure.



The perfect combination

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Resort or Liveaboard? You can enjoy the best of both at Wakatobi. Begin with a stay at the resort, known as one of the world's best diving destinations. Here, you'll have daily access to more than 40 dive and snorkel sites, as well as unlimited opportunities to explore Wakatobi's renowned House Reef. Enjoy fine dining and the comforts of beachside villas and bungalows. Discover what five-star service means as the resort staff anticipates and meets your every need.

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Discover the possibilities of a combination resort and liveaboard experience. Contact a Wakatobi representative at office@wakatobi.com.

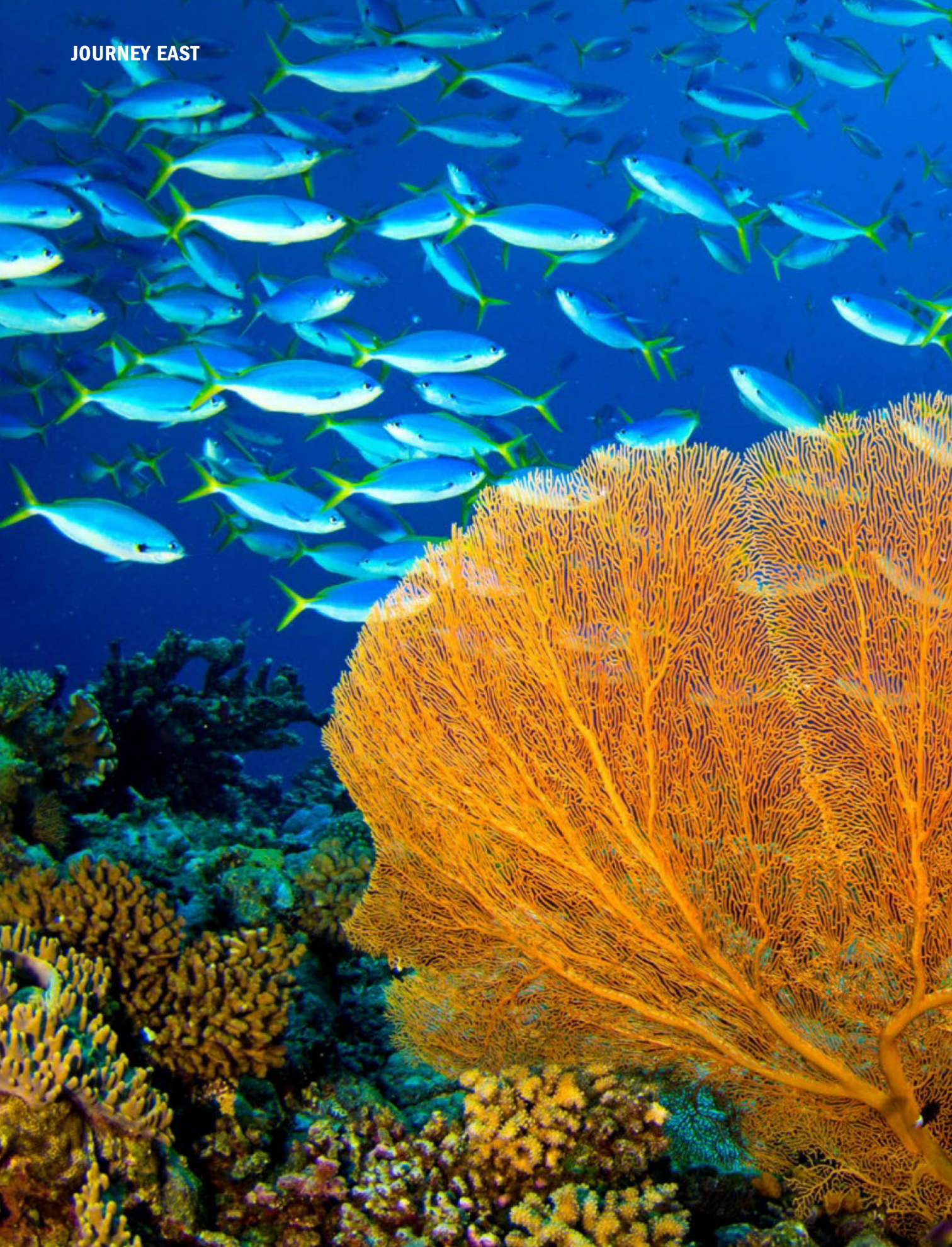
"We spent the first week on Pelagian and the 2nd week on the island. The Pelagian was spacious and comfortable, like being in a 5 star hotel! Wakatobi resort was just as amazing - staff, accommodation, food, diving - all out of this world. Dive instructors ensured your experience was personal and you got the best out of your trip."

Nicola Willis, August 2014



www.wakatobi.com

JOURNEY EAST





THE MARSHALL ISLANDS

THE MOST EXCITING PLACE YOU'VE NEVER HEARD OF

By Brandi Mueller

1. Blindingly colourful reefs crammed with fish await intrepid divers prepared to venture eastwards into the very middle of nowhere

It is hard to pronounce, even harder to spell, and most people have no idea where it is. But Kwajalein is one of the world's largest atolls: It's part of one of the largest shark sanctuaries, played a role in the Pacific theatre of WWII, and boasts some of the most pristine reefs on the planet.

OCEANIA



Located in the geographic region of Micronesia, Kwajalein (*kwa-ja-leyn*) is one of 29 atolls belonging to the Republic of the Marshall Islands. So far to the east, the Marshall Islands are just slightly west of the International Date Line and just a bit north of the equator. The islands cover over 1.26 million square kilometres (larger than South Africa), although only 171 square kilometres of that area is land (about the same size as Indonesia's Komodo Island).

Atolls are ring islands that enclose a saltwater lagoon. They are formed by coral reefs that built up around a former island that has since disappeared over millions

of years due to erosion. Flat and skinny islands of sand are left behind, usually with sheer walls on the ocean side and a protected lagoonal area fed by tidal influxes on the inside.

For Kwajalein this means spectacular walls dropping hundreds of metres right offshore with untouched, healthy corals and lots of pelagic life, and a lagoon of around 20 to 40 metres deep with sporadic coral heads and, thanks to World War II, copious wrecks including American and Japanese warships and planes.

2. The wreck of the *Prinz Eugen* is one of the iconic dives at Kwajalein

3. The lagoon is littered with the wrecks of more than 160 sunken planes



“These wrecks have become stunning historical monuments, covered in sponges and corals and teeming with fish life.”

PACIFIC NAVIGATORS

Getting to the Marshall Islands must have always been an adventure. Today's sailors have extensive GPS and electronic navigation systems to help them and there are limited (although sometimes unreliable) flights to this remote location. But how did early navigators possibly find these islands in the first place?

Little is known about those who first arrived in the Marshall Islands over 3,000 years ago. It is not clear where they came from or how they found their way to this remote corner of the Pacific Ocean, over 5,000 kilometres east of the Asian continent.

Once here, navigators used stick charts to navigate. Stick charts were handmade coconut frond and shell maps used to depict islands and prevailing ocean surface swell patterns. By memorising these patterns, navigators could move from island to island without the use of GPS, compasses, or maps as we know them.

WORLD WAR II

The lagoon of Kwajalein Atoll is the resting place for a huge concentration of Japanese and American WWII wrecks, including more than 25 ships and over 160 planes. The Japanese took over and colonised the Marshalls in 1914 and used Kwajalein as an important military defence base during WWII. In early 1944 American forces invaded Kwajalein, bombarding and destroying all of the Japanese aircraft and sinking many ships.

These wrecks have become stunning historical monuments, covered in sponges and corals and teeming with fish life. Whitetip sharks can be seen resting on the submerged decks and schools of batfish patrol the kingposts, seeming to watch over the ship and coming in close to inspect divers as they explore the wreck.

POST-WAR GRAVEYARD

When the war ended, the Americans were faced with the question of how to get their excess materiel back, including around 150 planes. It was decided it would be cheaper to get rid of the planes than to bring them back on ships, so they were simply pushed off the back of barges in the lagoon near Roi half a dozen square kilometres. These planes can be found at both deep and shallow diving depths, most around 30 metres, and in one area as many as 13 planes can be seen on a single dive.

The Airplane Graveyard has been called the most extensive collection of American WWII planes in one place. You'll find Corsairs, Wildcats, a Helldiver, Avengers, Dauntless, PBJ-IH Mitchells, and more. Most



of them sit on the sandy bottom looking like they have just landed, while others are nose down, upside down and in all other directions. There is also a Japanese Zero, which likely went down as a result of an accident while it was trying to take off or land before the end of the war.

RADIOACTIVE SHIPS

On the other side of the world, the *Prinz Eujan*, a German war cruiser, was given to the United States as a prize of war at the end of World War II. It sailed from the Northeast Atlantic to the east coast of the US, where it was decided the *Eujan* would make a great addition to the 95 ships of the “nuclear fleet”. Continuing its journey west, the *Eujan* was towed through the Panama Canal and moved into the Pacific, making its way to the Marshalls.

In 1946, several hundred miles from war-ravaged Kwajalein, those 95 ships were being lined up in the lagoon of Bikini Atoll for Operation Crossroads. They were to be used to investigate the effects of nuclear weapons on warships. Two “Fat Man” plutonium implosion-type nuclear bombs, named the Able and the Baker, were dropped on the *Eujan* and the other ships.

At the end of the test, only nine ships had survived enough to be moved, and the *Eujan* was towed back to Kwajalein Atoll for further studies. Although most of the structure was intact and the ship was in fairly good condition, a small leak in the hull would be its demise. Due to the residual radiation no one could board the ship to repair the hull. It sank in shallow waters next to the island of Enubuj (also known as Carlson).

Today the *Prinz Eujan* can be seen by anyone who flies to Kwajalein or sails near the south part of the lagoon. One of the two remaining props and the rudder stick out of the water. Boats anchor next to the ship close to the island and divers descend to about 12 metres to see the top deck sitting at an angle in the sand. Large marble rays are common under the deck and coral-encrusted ladders, winches, and other machinery can be seen. The ship lies on a slope that proceeds to around 40 metres where the bow is in the sand. Many port holes give views of upside down beds and chairs and one opening shows six possibly still live torpedoes stacked on top of each other.

Ammunition can be found in the sand below the wreck as can whitetip reef sharks sitting in the sand. At the stern of the ship, brave divers can swim underneath it to the other side of the wreck and then ascend up the massive hull to the top of the ship, which is actually the bottom. This part of the ship is covered in coral, and large schools of parrotfish, fusiliers, and others dart back and forth around the hull.



5

TODAY

It still isn't easy to dive Kwajalein Atoll. One commercial flight does arrive six days a week from either Guam or Hawaii and only transient liveaboard dive boats occasionally make their way to Kwajalein (usually to continue to Bikini Atoll). There are no commercial dive operations although the army base has an active scuba club for those stationed or working there.

The WWII wrecks have been underwater for 70 years and are encrusted with coral and sponges. Most of the wrecks are home to various turtles, sharks, barracuda, schools of curious batfish, and an array of reef fish.

Once a diver has seen the wrecks, a trip outside the lagoon reveals an entirely different world: sheer walls dropping away into the blue; untouched, pristine coral extending down as far as you can see; sea fans larger than most people, coral heads that look like they're on steroids, and countless fish of all shapes, sizes, and colours. A glance out into the blue usually rewards divers with sightings of schools of tuna, eagle rays, and even a whale shark or two. The islands are visited by multiple species of whales, dolphins and sharks.

Within the lagoon, random coral heads emerge out of nowhere. One particular favourite is known as

Troy's Coral Head, where shark sightings are virtually guaranteed. Often a large bait ball is circling the coral head with sharks patrolling it, occasionally taking a bite from the fish buffet, but otherwise just wrangling the fish for dinner at a later time.

If the wrecks, rays, corals, dolphins, and sharks don't please you, I'm pretty sure nothing will. But to step it up one more notch, things are still being discovered in Kwajalein's lagoon. The search for other warships and planes continues to this day – several of which are known to be out there somewhere, but it is more than likely that there are many more waiting to be discovered that no one has any idea about at all.

Some places are simply never boring, and this, at Asia-Pacific's easternmost boundary, is one of them. Kwajalein, the most exciting place you've probably never of heard of (before now), is simply bursting with the kind of subsea adventure that would satisfy even the most daring of explorers. [SDAA](#)

5. This is possibly the most extensive collection of American WWII planes in one place in the world.

6. If the wrecks don't do it for you, the healthy waters are also abundant with diverse marine life



6

Brandi Mueller is a dive instructor and boat captain and has been diving for over half her life. Brandi's obsession with the sea began at age 15 when she explored diving for the first time as an exchange student in New Zealand, and culminated when she became an instructor at age 21 after studying seagrass in Florida. These days, when not driving the boats or teaching divers, she is most happy underwater with her camera.



◀ GUAM

▼ KWAJALEIN ATOLL

MICRONESIA



NAVIGATOR

Getting there:

United Airlines flies to Kwajalein from Hawaii or Guam every other day except Sunday. Kwajalein Island is a secure US Army Base and only those with permission can stay on the island. Everyone else has to take a ferry to the island of Ebeye. Currently the only commercial diving operation is the MV *Windward* liveaboard that runs out of Ebeye.

Best time to dive:

Diving is year round. Water temperatures are between 26 and 27 Celsius all year, but the sea is a bit choppy from December to April.

Essential training:

The wrecks can be deep, so advanced certification is recommended.

INTO THE EAST



AS EAST AS EAST

You don't get much more remote than this.

Head out to the fringes of Asia-Pacific for diving adventures in the middle of nowhere – places that are so far east they are practically in the west. The island nations dotting the eastern expanse of the Pacific are gateways to clear, warm, pelagic-filled water; paradises of coral and tropical fish.

Samoa

13°50' S, 171°45' W

Want to get off the beaten track? Think about heading to Samoa. Varied topography, lagoons, deep-water pinnacles, passages and barrier reefs – means diving to suit everyone from macro lovers to adrenaline junkies looking for a good drift.

Sharks are out in force with grey reefs, whitetips, blacktips and silbies. Choose between scoping the blue for barracuda and trevallies, or scouring the reef walls for nudibranchs and octopods.

Fiji

18°10' S, 178°27' E

Most divers don't need an introduction to the soft coral capital of the world – a place famous for its bright turquoise water ablaze with Technicolor life. Fiji boasts more than 10,000 square kilometres of coral reef and more than 1,000 species of fish.

Nutrient-rich currents sweep into these palm-fringed islands, bringing in the currents that underpin the dizzying marine community here. Sharks, turtles and mantas all put in appearances in Fiji, alongside the reef dwellers and critters for macro fanatics.

Chatham Islands, New Zealand

44°02' S, 176°26' W

This rugged outpost is battered by ocean swells from the Pacific, but when the conditions are right, the cool waters are clear, and life is abundant in the kelp beds. Rocks are carpeted with abalone ("paua") and swaying sea tulips, above which swim spotties, banded wrasse, butterfish, grouper and blue cod.

Out in the blue, opportunities to dive with great whites! Evidence of the ancestors of these predators is scattered along the shores of Te Whanga Lagoon, where fossilised shark's teeth are the prize for the determined.

Kiribati

1°28' N, 173°2' E

A place so far east it could be considered the place where the sun actually rises – Kiribati, an island chain scattered over thousands of miles, is the first inhabited place to welcome each new day, since it unilaterally decided to shove the International Date Line over a bit so that it would no longer be splitting the country into two different days.

Kiribati is also home to some stunning diving. With visibility up to 45 metres, there is plenty of opportunity to spot pelagics passing by, and to marvel at the colour and diversity of the coral. Christmas Island is the largest and one of the oldest coral atolls on the planet and has been called 'the last untouched reef in the world' by ichthyologists from the Smithsonian Institute as a result of its sheer numbers and diversity of fish.

French Polynesia

17°34' S, 149°36' W

World-class diving and a heavy side order of romance to boot, French Polynesia has long been known as an iconic honeymoon destination – probably because it's so bloomin' far away from anywhere and anyone else.

Of French Polynesia's 118 islands, there are 11 go-to dive destinations: Bora Bora, Raiatea, Huahine, Moorea, Tahiti, Tikehau, Nuku Hiva, Tubuai, Rurutu, Rangiroa and Manihi.

The diving here, like much of the Pacific's far-flung volcanic atolls, is about lagoons, walls and passes. You can take your pick from shark and stingray dives, friendly napoleons or high-octane drifts full of mantas and schools of sharks. [SDAA](#)

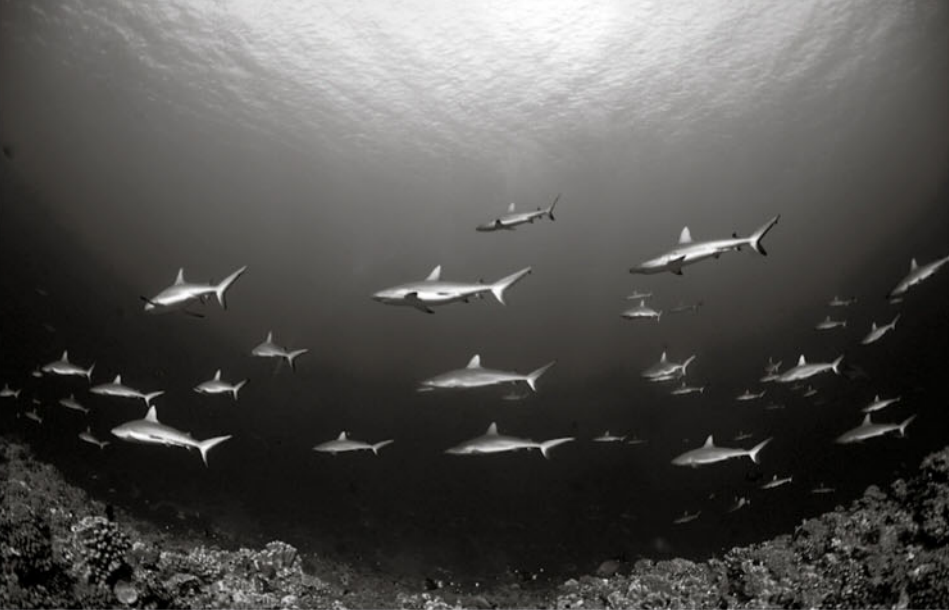
Images. Tahiti's reefs in French Polynesia are home to schools of sharks and colourful reef fish – vibrant, exciting rewards for intrepid divers heading out into the Pacific. Images © Aaron Wong

Cook Islands

21°12' S, 159°46' W

Fifteen little volcanic islands in the South Pacific make up the Cook Islands, a sovereign nation in free association with New Zealand.

Diving here promises stunning visibility, breath-taking hard corals, canyons, caves and drop-offs inhabited by rays, sharks, turtles and barracuda, and, between July and October, humpback whales. Highlights include the famous Ngatangila swim-throughs, Koromiri Coral Garden, and the Matavera Drop-off. For dive centres make your way to Rarotonga and Aitutaki.



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AMOS NACHOUM

He freedives with blue whales off the Eastern Pacific, scuba dives in the Okavango Delta with crocodiles and goes face to face with great white sharks. Here, the charismatic master of big animal photography shares a few of his most iconic shots.

Since 1980, Amos Nachoum has explored every significant body of water in the world, from the North Pole to Antarctica, all the while shooting the massive and often misunderstood creatures that inhabit them. For decades, his resulting work has appeared in the world's leading publications, from the mainstream media to specialist titles, and has twice won the animal behaviour category in the BBC Wildlife Photographer of the Year Award.

Amos seeks to express respect and compassion for animals and wilderness, to raise awareness of ocean giants, to dispel myths of “dangerous” wildlife, and to promote harmonious interactions between man and beast. To this end, Amos leads intrepid, once-in-a-lifetime wildlife photography expeditions with his company *www.BigAnimals.com*, on which he introduces his guests to majestic creatures in their natural habitats through enchanting encounters like these...

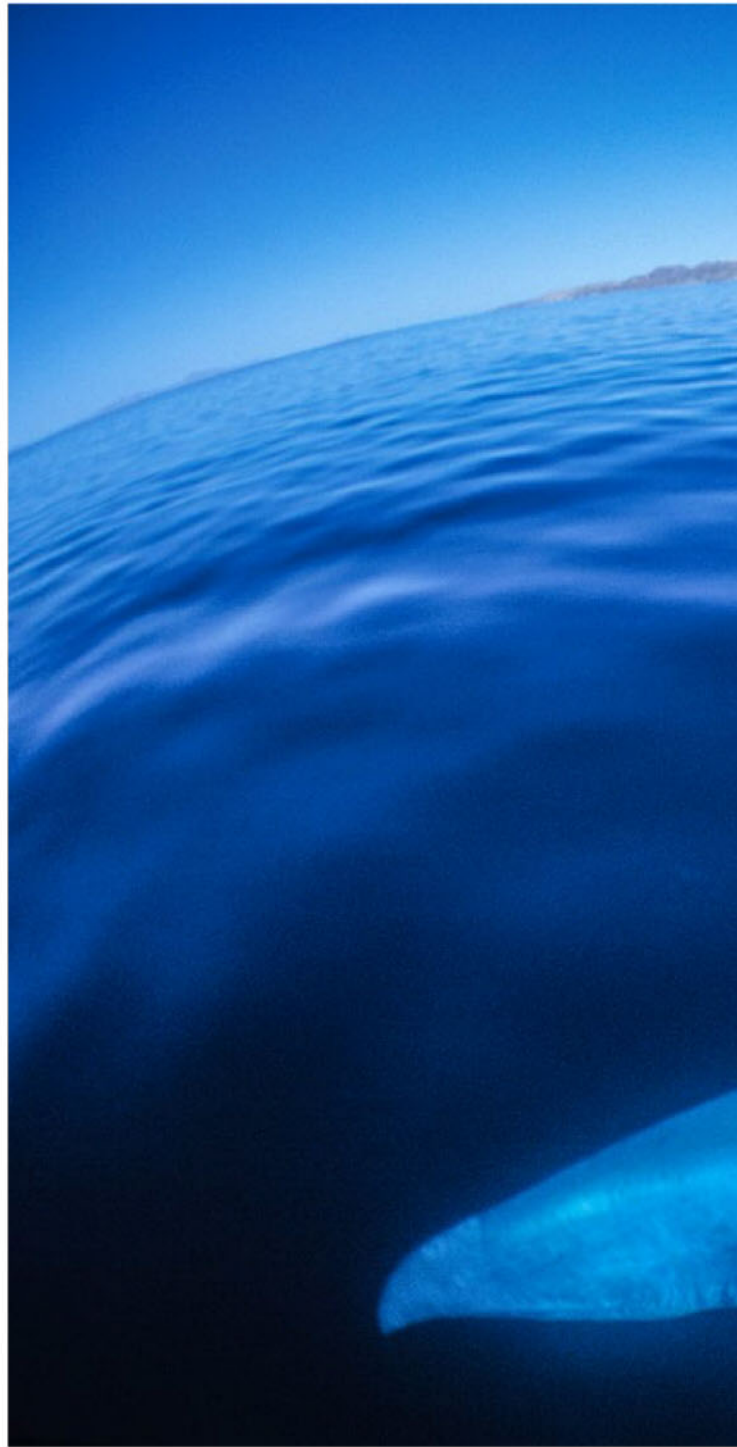
THE LARGEST TAIL IN THE WORLD

Sea of Cortez, Mexico

I always try to create different images of subjects that have been shot before.

In 1986 the renowned whale photographer, Flip Nicklin, published a picture of a fin whale captured in the late evening, with a purple light bouncing off Baja California's mountain peaks. The image was burned into my memory.

In my pursuit of the biggest animal on the planet, the blue whale, I went to Baja in 1995. It was a sunny, hot day and the water was calm. I was sitting in a fisherman's panga with Jose, a Mexican fisherman who spoke no English. I spoke no Spanish, but we both understood the words “*azul ballena*” – blue whale. We had been searching for hours and by now were far from La Paz. We had seen a few distinct blows of a blue whale in the



distance, but never close enough. Noon passed and by two I started to get sleepy, thirsty, and my mind was wandering. Then Jose whispered, “*Azul...*”

I jumped up, looking around, but could not see anything. Jose cut the engine and started rowing, I still couldn't see a thing. As I kept looking, Jose was gliding the panga through the water, when, all of a sudden, it appeared – right in front of the panga, the whole body of the 25-metre whale revealed across the bow.



I ran to change my lens for the fisheye to try to capture the whole whale in the frame, but at the moment I was ready to take the picture, Nicklin's image popped into my mind. Rather than copying it I found myself gesturing madly at Jose to back up and get behind the tail. Jose manoeuvred the panga quietly, not to wake the sleeping giant. As we approached the whale, I extend my body over the front of the boat and lowered my hands towards the surface to take the picture from 20 centimetres above the

water, capturing the whole seven metres of the tail's span and Catalina island in the background.

NIKON F4, 16MM FISHEYE LENS

SETTINGS: 1/250s, f/22, Provia 100 ASA film pushed to ISO 200



FAT ALBERT

Okavango River, Botswana

Fat Albert is a five-metre-long Nile crocodile with a bad reputation. He was relocated by the people living along the Okavango Delta to some 150 kilometres from where he was first seen, as it was noticed that he seemed a bit too interested in people, and particularly in the tourists' red life vests.

Photographing Fat Albert in his natural environment was a great opportunity to dispel a myth, and to lead a few people into the adventure of a lifetime.

Although we know Fat Albert's location, he is hard to find, and the window of opportunity for diving safely with these crocs is limited to four weeks a year during which the water is cool and outside is warm, and the crocs prefer to stay on the riverbank absorbing the Sun's heat.

The most exciting part of the dive is the preparation, the search, and the anticipation. Knowing roughly where he would be, we backtracked with the vessel until I decided to hit the water. My guest, safety diver and I back-rolled in and started drifting with the current, carefully searching the riverbank.

It is hard to spot a croc underwater – they are well camouflaged. Seeing the row of white teeth glowing through the murky water against the muddy backdrop was a great relief, knowing that we could now take his picture and exit the water safely.

CANON 1D MARK IV, 14MM LENS, SEACAM HOUSING

SETTINGS: 1/200, f/5, ISO 250

ANACONDA UNDERWATER

Amazon river, Brazil

The six-metre-long green anaconda is another misunderstood big animal. When I arrived in Brazil five years ago and people heard that I was planning to dive with the anaconda, they called me crazy. These days it is crazy just how many people want to do the same thing. It took me two years to convince the locals to lead me to the river where the snakes are.

Every morning we left early, with the skipper seated at the back and three of us rowing up current, watching for an anaconda bathing in the sun on the bank. The river is full of patches of shallow water and obstacles, and we had to keep getting off the boat to lift it, moving

it over or around rocks and tree trunks. I kept telling myself that after all this effort it had better be an epic encounter.

But, after seven days of seeing snakes on the river but none underwater, it start to dawn on me how difficult it may be. After 10 days, we had not been rewarded, and decided to extend the trip by one last day.

At 11am as the sun was hitting its peak, I noticed a large anaconda bathing in the sun. But despite all the commotion on the boat, the snake did not move. Our guide went to go ashore, and, as soon as he placed his foot on the ground, this giant, six-metre-long snake slowly uncurled itself and glided into the clear water.

I followed and drifted down current with the snake for about a kilometre and a half. Almost 30 minutes after we had got into the water, I saw a patch of green vegetation up ahead and could only hope the anaconda would follow me. I raced to get there before the snake and, sure enough, just seconds later, it showed up directly in front of the lens with its tongue out, sensing me. I was out of the river the moment the anaconda touched my dome, and on the way home with the first image of an anaconda underwater.

As with all big animals, knowledge and experience are the enemies of fear.

CANON EOS-1DS MARK II

SETTINGS: 1/200s, f/4, ISO 250

LEOPARD SEAL AND PENGUIN

Antarctica

Behaviour, preparation and passion are the basic building blocks for successful wildlife photography, and particularly underwater as there we are limited to only one camera and one lens at a time.

The predation behaviour of the leopard seal is long and elaborate: from the shallow water ambush of a colony of young chicks, then moving back to the open water to drown the penguin in a game of catch and release, and culminating in this climactic point just before the hungry leopard seal devours its prey. It took days of observation to pin point this moment, and about six hours to shoot in the freezing cold Antarctic water.

CANON 1DS MARKIII, 15MM LENS, SEACAM HOUSING

SETTINGS: 1/125s, f/4, ISO 400









SLEEPING POLAR BEAR

Arctic Bay, Canada

Life is tiring even for the mighty polar bear, living on the edge of the floe, searching for seals and not finding any. Eventually they fall asleep in the heart of the snowy desert.

I was tracking the prints of one adult female and two cubs, when, totally by surprise, my Inuit guide called me from his viewing post. All I could see at first was a yellowish stain on the white ice, but after a few minutes I understood what my guide was telling me about the plight of the bears in light of fast diminishing ice caps and sources of food.

We took our time, monitoring the wind direction, and when it was blowing downwind from the bear, we were able to get in as close as three metres away. All the while, our Inuit guides were incredibly protective, on high alert, and ready to pull us out. But it wasn't necessary. I got close enough to fill the frame, as did my guests, and we all finally moved away cherishing the unique moment of opportunity.

NIKON F4, 300MM LENS

SETTINGS: 1/400s, f/5.6, Provia 100 ASA film

WALRUS MOTHER AND CUB

Canada, High Arctic

We were searching for a swimming polar bear to shoot, when we happened across this walrus mother with her cub, resting on the floating ice.

Our Inuit guide was looking through the binoculars at the pair when he spotted a polar bear with its cub swimming toward the iceberg and the walrus.

I grabbed my 300mm lens, and, as the bear approached the iceberg, the mother walrus stood up, hovering over her young one in a defiant attitude of protection. The polar bear, intimidated, veered away, without disturbing this touching shot of a mother lovingly protecting her offspring.

300MM LENS

SETTINGS: 1/400s, f/5.6, ISO 200





GREAT WHITE OVERHEAD

Guadalupe, Mexico

There is a big difference between taking a picture and making a picture – and yes, we can make pictures underwater, although we can't direct the wildlife into the frame.

What we must do is observe the animal's behaviour, frame the image and its composition in our mind and then set the camera for the event. Yes, this process means I have missed many other images, but most of

them had already been filmed before. Still, seeing a great white overhead is not only a spectacular view, it is also a very rare event.

In most cases great whites swim directly at eye level and then come in as close as a few feet before circling downwards. So, on this day, I was surprised to see the shark directly above me, and better yet, the image struck a chord in my photographer's mind.

The first attempt to capture the silhouette was a failure; I couldn't change the camera settings fast



enough to shoot upward against the sun. For the next opportunity I set the camera up for only that moment with a fast shutter speed and manual focus on infinity. In a whole day of diving I only got one picture, but a very rare one... [SDAA](#)

CANON 1DS MARK III, 16-35MM LENS, SEACAM HOUSING

SETTINGS: 1/1000s, f/8, ISO 400

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underwater
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AUSTRALASIA Underwater celebrated images taken in Asia-Pacific. The competition reached its climax at ADEX China on September 22, 2014, when the winners were announced at a LIVE JUDGING event, featuring a panel of world-renowned members of the underwater photography community: Ernie Brooks II, Aaron Wong, Qing Lin, Yorko Summer, William Tan, and Wu Lixin. Here are the winners!

COMPACT

WINNER

Alberto Gallucci
*"Thysanostoma
thysanura"*
Bali, Indonesia

RUNNER-UP

Uwe Schmolke
"Nudi"
Bali, Indonesia





WIDE-ANGLE

WINNER

Scott Portelli
"Humpback Whale"
 Tonga

RUNNER-UP

Iyad Suleyman
"Turtle 3"
 Sipadan, Malaysia

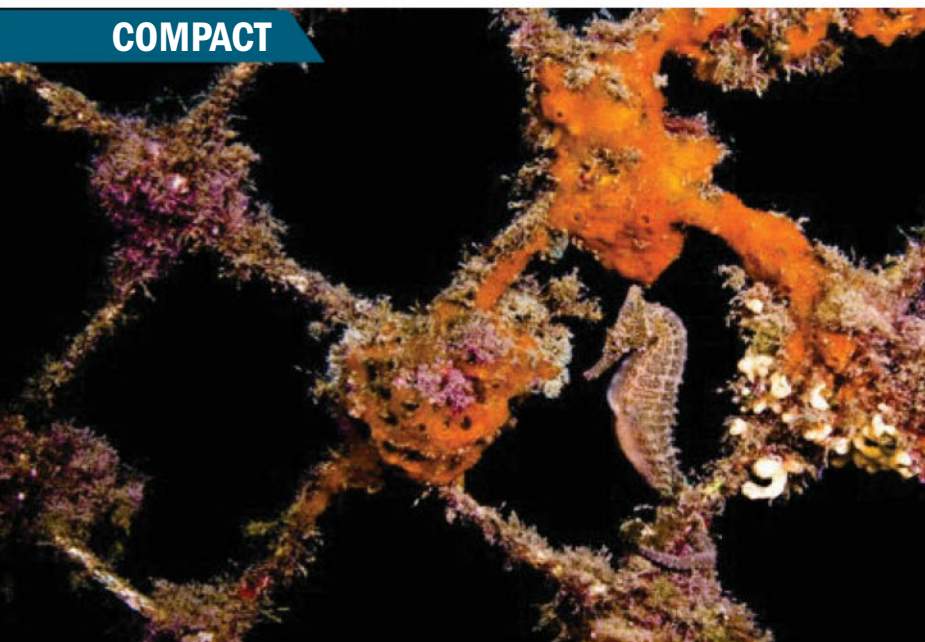


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COMPACT



WINNER

Jim Chen
*"Coral Reef
 Restoration Project"*
 Bali, Indonesia

RUNNER-UP

Michael Gallagher
"White's Seahorse"
 Sydney, Australia

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Winner of the
People's Choice Award



MACRO

RUNNER-UP

Davide Lopresti
"Pink"
Komodo, Indonesia

WINNER

Lynn Wu
"Sheep Eat Grass"
Bali, Indonesia





ADEX
亚洲
潜水展
CHINA



WINNER

Vincent Truchet
“Flying Shark”
Polynesia

CONGRATULATIONS to
Vincent Truchet who stole the
show at ADEX China **NO LIMITS**,
taking home both the winner
AND the runner-up spots!

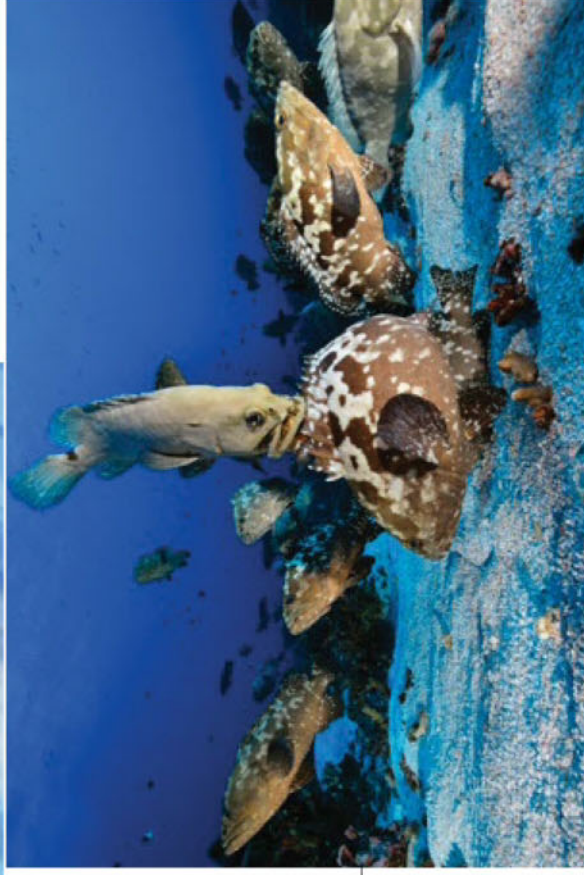
ADEX CHINA **NO LIMITS** UNDERWATER PHOTO COMPETITION

This contest was open to images taken anywhere around the world and with any system, wide-angle, macro, colour or black and white; we were just looking for pictures with the “wow” factor.

From 10 anonymous shortlisted images, a panel of world-famous experts selected one winning image and one runner-up in a live judging event at ADEX China on September 21, 2014. Huge thanks to the esteemed judges for being part of this exciting competition: Stephen Frink, Ernie Brooks II, Aaron Wong, Qing Lin, Yorko Summer, William Tan, and Wu Lixin.

RUNNER-UP

Vincent Truchet
“Grouper Fighting”
Polynesia



NO LIMITS SHORTLIST

1. Christian Llewellyn
"Untitled"

2. Christian Llewellyn
"Untitled"

3. Jim Chen
"Red Coral Goby "

Taiwan





4



5



4. Raffaele Livornese
"Apogon Feeding"
Naples

5. YuPing Chen
"Pink Eyes"
Anlao, Philippines

6. Shang-Yu
"Crinoid Shrimp"
Dauin, Philippines



6

NO LIMITS SHORTLIST



7



8

7. Raffaele Livornese
"Goby Pair"
Anilao, Philippines

8. Vincent Truchet
"Night Hunting"
Polynesia

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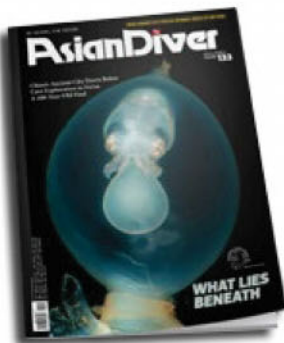
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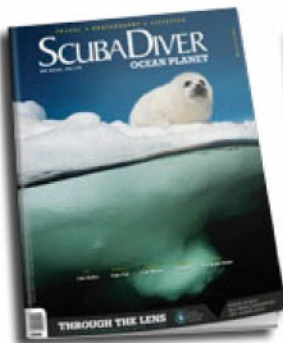


The Historical Diving Society Asia (HDSA), a not-for-profit society established in Singapore to serve the Asian region, aims to educate and preserve the history of diving in all forms. It produces stories and information on Asia's diving history in every issue of *Asian Diver*, its official publication. All subscribers to *Asian Diver* automatically become members of HDSA.

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Scuba Diver OCEAN PLANET and Scuba Diver AUSTRALASIA

Eight Issues Per Year (Every 45 Days)



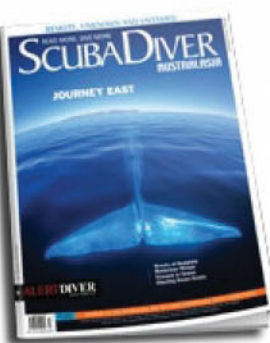
Scuba Diver OCEAN PLANET covers destinations around the world, responding to the needs of today's divers. Tailored content provides readers with exciting insights in the incredible destinations, with gear, gadgets and activities for time spent both above and below the waves. *SDOP* is published in collaboration with DivePhotoGuide.com to include *THROUGH THE LENS* – dedicated to underwater photography and videography. *SDOP* is also the official publication of the HANS HASS FIFTY FATHOMS AWARD.

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THE HANS HASS FIFTY FATHOMS AWARD

The HANS HASS FIFTY FATHOMS AWARD is awarded in one of two categories: Arts and Literature in recognition of Professor Hass' pioneering work in both underwater imagery and printed word, and Science and Technology in recognition of Professor Hass' pioneering work in marine sciences and underwater technical innovation. The Award is a framed cast bronze plaque, designed and donated by ocean artist Wyland, showing an image of Hans Hass from his solo 1949 Red Sea Expedition.

www.hds.org/hans-hass-diving-to-adventure-award



Scuba Diver AUSTRALASIA is a regionally focussed magazine, staying true to its roots with editorial exclusively covering Asia-Pacific, with one story from Australia in each and every issue. *SDAA* specialises in dive travel and marine conservation, and is the official media partner of Divers Alert Network (DAN) Asia-Pacific. DAN's magazine *Alert Diver* is published across 32 pages of every issue of *Scuba Diver AUSTRALASIA*.

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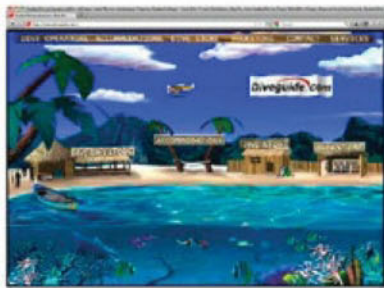
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WOW



ON THE DESCENT

Apo Island, near Dumaguete, Philippines

By **Alex Mustard**

I spotted this snake heading to the surface for a breath of air and, knowing what goes up, must come down, I got into position. Experience has taught me that air breathers don't like being on the surface and usually dive vertically back to the reef after breathing.

So I swam directly beneath the snake and took a test shot to ensure my exposure. Then, moments later, it dived straight at my camera and I was able to take this photo with my fisheye lens.

ALERT DIVER

The Magazine of Divers Alert Network Asia-Pacific



**THE TREMENDOUS TUNA
EMERGENCIES IN THE BACK OF BEYOND
OXYGEN SUPPLY
HYDROTHERMAL VENTS**



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Alert Diver is a forum for ideas and information relative to diving safety, education and practice. Any material relating to dive safety or dive medicine or accident management is considered for publication. Ideas, comments and support are encouraged and appreciated. The views expressed by contributors are not necessarily those advocated by DAN Asia-Pacific. DAN is a neutral public service organisation which attempts to interact with all diving-related organisations or persons with equal deference. *Alert Diver* is published for the use of the diving public and it is not a medical journal. The use and dosage of any medication by a diver should be under the supervision of his or her physician.

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Photos by Stephen Frink*

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PERSPECTIVES

Our second “Big Initiative”

 In the previous issue of *Alert Diver I* described “Oxygen First Aid Preparedness” being the first of DAN Asia-Pacific’s two “Big Initiatives”: having the right equipment (such as the multi-function regulator and demand valve in every DAN O₂ kit), having all staff trained, and, last but not least, having enough supply – and not just for the boat trip to the beach but for as long as may be needed to get to professional medical care – which could be overnight in the case of a liveaboard or remote resort. On page 10 of this issue you will find a case example that reinforces the importance of this initiative.

The second DAN Asia-Pacific “Big Initiative” is improving local medical clinics’ ability to assess injured divers and provide early care prior to the diver’s transport to a recompression chamber. Depending on the location, this may extend beyond the dive industry and may involve public or government supported facilities offering the most basic of medical services.

In the DAN worldwide system for management of a diving accident, standard operating procedure is to send divers with signs or symptoms indicative of decompression illness to the nearest emergency room to provide immediate support with vital sign monitoring, fluids, oxygen and, most importantly, an accurate neurological system examination, including signs and system assessment and medical history, best carried out by a physician. Frequently,

however, due to a lack of familiarity with decompression illness, referred divers do not receive a neurological exam and often are provided only low flow oxygen (20–30 percent), which is much less efficient in removing nitrogen, that’s if they receive any oxygen at all. In some locations, oxygen is in low supply – a major disincentive for remote clinics to provide it to divers who present with what appear to be minor symptoms.

The Plan

Our primary method of improving remote clinic capacity will be through regional seminars for their physicians. Additionally, there will be a wider distribution of non-rebreather oxygen masks and information for medical professionals on early care and assessment. In some cases, DAN support may include free non-rebreather masks for certain dive operators and free non-rebreather masks or even possibly O₂ equipment for selected remote and underfunded public clinics.

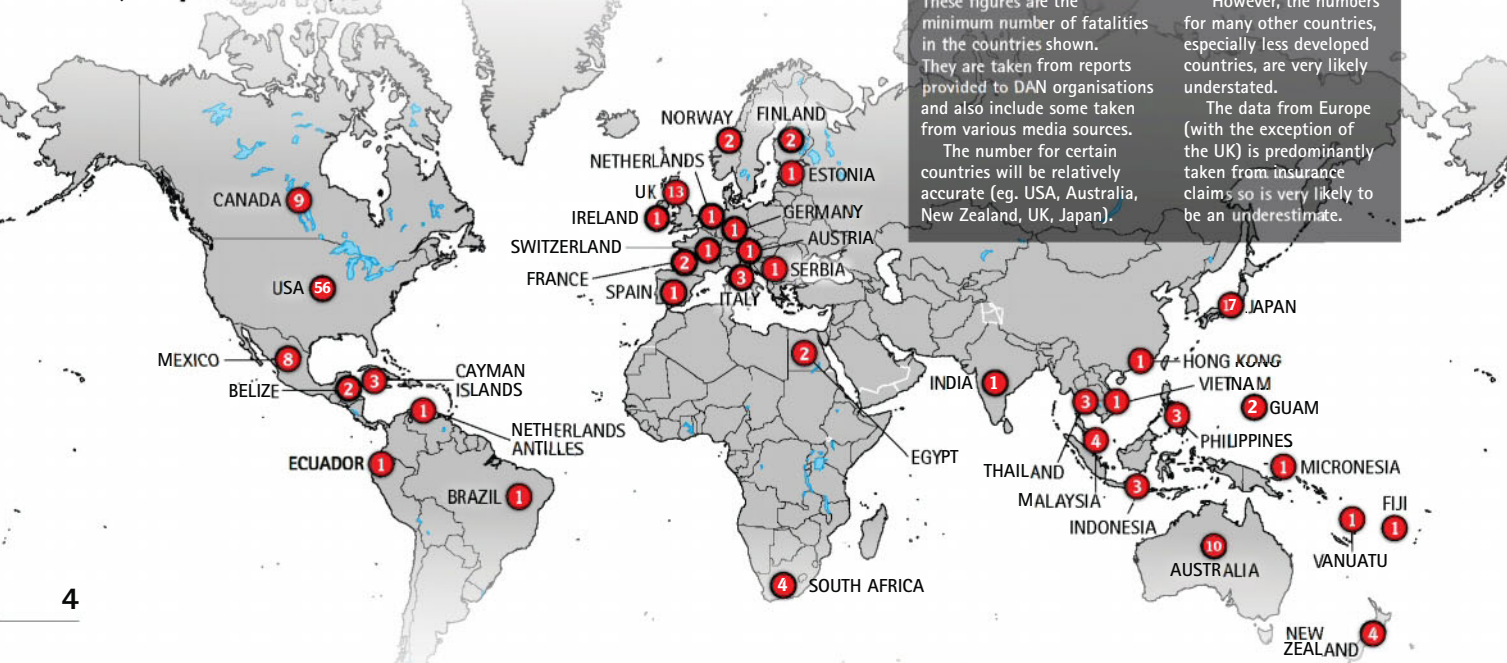
In the months ahead, we will report on DAN’s two “Big Initiatives” and how you, the diver, can support them. One of the most important ways you can offer your support is by being a Member of DAN Asia-Pacific. You can join today at www.danap.org/join.php.



Safe diving,
Chris Wachholz, CEO,
DAN Asia-Pacific:
Divers Helping Divers

2013 DIVING FATALITIES

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LETTERS

From our members

Bubbling Concerns

I just received my copy of the latest *Alert Diver* magazine. Something was bothering me and I realised the majority of photos of divers in this issue are holding their breath, either in the articles or advertisements. I know it's common to stage photos but it seems a subtle, perhaps even subliminal, message that holding your breath is ok. Perhaps not the best message to send as a diving safety journal?

- Rob Michaelson

Robert, thanks for your comments. We have no editorial preference for bubbles or no bubbles. I think it is just luck of the draw which appear in print. I know that I, as a professional underwater photographer, instruct my models to use normal breathing pattern relative to my photo needs. People breathe underwater and if photos show bubbles it is a part of the natural order of things.

A relaxed diver will spend more time underwater without bubbles than with the moment of exhaust bubble, even without holding their breath. But, you are right, dive safety is our number one concern. I will say as photo editor for Alert Diver, I've never rejected a photo because there were exhaust bubbles evident.

Thanks!
Stephen Frink

Keep It Current

I just received the Quarter 3 issue of *Alert Diver* and found it packed with information. The member submitted stories were the most educational of all, especially "Just Another Day at the Office" (DAN Was There For Me) by Meghan K. MacCollum. I have always put safety first and have not had any incidents requiring DAN's assistance, but MacCollum's story reinforced to me the need to make sure I keep my DAN dive-accident insurance up to date. As she stated several times, she was diving in shallow water and still got symptoms. Her story also lent insight into how DAN assists after such an incident. This gave me more confidence in DAN's ability to help us diving professionals when we are having just another day at the office. Thanks also for helping me keep my marine-life identification skills sharp. I like to guess at the identity of the creatures in your pictures, and whether I am wrong or right, I always learn something.

- David Crawford



Image © Stephen Frink

Thanks David! Meghan's experience highlights the importance of, first and foremost, accepting that something is wrong and needs to be quickly acted upon. Divers are often slow to react. It also shows the benefit of having quick access to a suitable oxygen unit and a sufficient oxygen supply. This can be invaluable in reducing the severity and longevity of DCI symptoms, as well as the number of recompression treatments required. Meghan's story also reiterates the importance of DAN AP's O₂ Preparedness Campaign, which we have discussed in the past few issues of Alert Diver. You will continue to hear more about this campaign as we continue to raise awareness in the dive media and throughout the diving community.

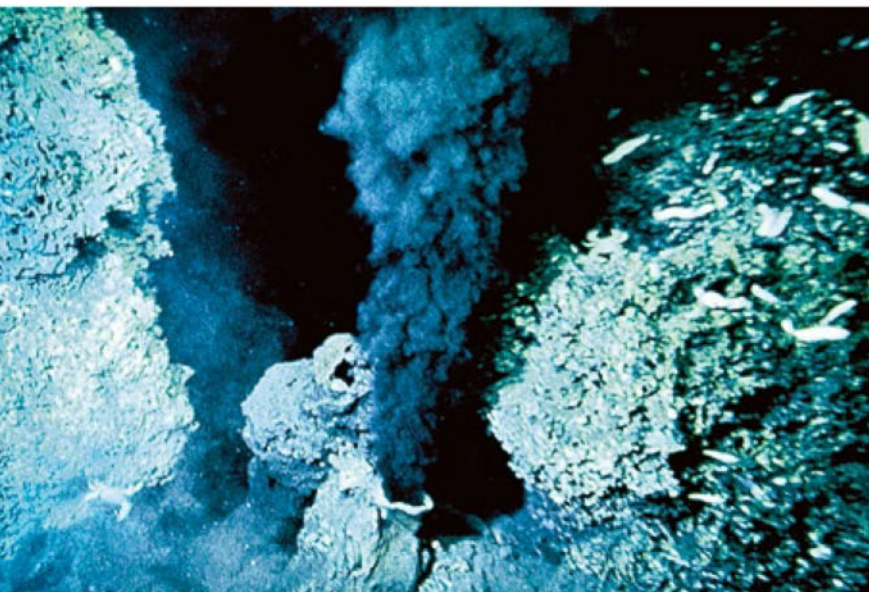
Meghan's words of advice were: "Always learn from the experiences of others and always educate yourself. Above all be cautious, be prudent and be safe. And if someone has an incident, don't judge them, as one day it could be you." In total, Meghan's expenses amounted to US\$28,000, which is something for uninsured divers to think about!

- John Lippmann

Hydrothermal Vents

Mysterious empires of the deep ocean

By Hillary Viders, Ph.D.



↑ A black smoker hydrothermal vent in the East Pacific Rise
Image © Ralph White

 Volcanoes traditionally conjure visions of Mount St. Helens-like behemoths erupting with lava flowing ominously down a mountainside. But not all volcanoes are on land nor are they always destructive. Hydrothermal vents are underwater volcanoes that play an important role in the ocean's temperature, chemistry and circulation patterns, and they contain extremely valuable resources sought by scientists, governments and private industry, creating debate about whether the riches are worth great risk.

LIFE AT 2,000 METRES

Although hydrothermal vents likely began forming millions of years ago, scientists became aware of them only 34 years ago. Found on seabeds at depths of more than 2,000 metres (7,000 feet), hydrothermal vents are often nestled among vast underwater mountain ranges. They form when the Earth's tectonic plates shift, creating cracks in the ocean floor and allowing geysers of mineral-rich water to escape.

Although most of the deep ocean where hydrothermal vents are found is sparsely populated, they are teeming with minerals and organisms. Since their discovery, more than 1,300 previously unknown species have been identified at vent sites, and even more new creatures are found with each visit.

The food web in the ecosystems of hydrothermal vents is 300 to 500 times more

concentrated than that of the surrounding waters. It is based not on photosynthesis (which requires light) but on bacteria that use the energy found in hydrogen sulphide, a chemical poisonous to most animals. Because the water from the hydrothermal vents is so rich in hydrogen sulphide, the bacteria are able to form dense masses in and around the hot water vents. Despite their microscopic size, the bacteria are the primary producers in the food web and support a wide variety of other marine life including tubeworms, giant clams, shrimp, mussels and lobsters.

WHAT LIES BENEATH

While the marine life of a hydrothermal vent is enough to keep anyone riveted, what really catches the attention of many on the surface are the potential riches to be found. Pound for pound, seafloor ore has more gold, zinc and silver than land deposits do. In 2009 Nautilus Minerals, a Canada-based seafloor-mining company, estimated there are thousands of vent systems under the sea, creating the potential for an annual yield of "several billion tons of copper" alone. Copper is a key component in construction, power generation and transmission, industrial machinery, transportation, heating and cooling systems, electronics, plumbing and telecommunications. Other minerals found in hydrothermal vents include nickel, cobalt and rarer minerals such as tellurium, which is used in the manufacturing of computers, CDs, DVDs and batteries.

But the value of hydrothermal vents extends beyond the minerals. Scientists have also discovered in hydrothermal vents microbes found nowhere else on Earth that may hold the key to the development of new drugs, industrial processes and other products. Scientists believe the microbes are as economically valuable as the vents' minerals because they are sources of enzymes used in DNA fingerprinting, detergents and the enhancement of oil flow from old wells. The microbes also produce bioactive compounds that may have pharmaceutical applications in cures for cancer and other diseases.

Even more fascinating, hydrothermal vents demonstrate accelerated biological and geological processes that far exceed what scientists believed possible. Taken together, the benefits of mining the riches of hydrothermal vents are proving hard to resist.

MINING HYDROTHERMAL VENTS

The mining, in fact, has already begun. Nautilus Minerals has a major seabed sulphide-mining project under way in the waters of Papua New Guinea. Canada, New Zealand and Australia have also set up mining operations at hydrothermal vent sites off their coasts.

But the most ambitious and expensive deep-sea mining project proposed to date belongs to China. After using remotely operated underwater vehicles (ROVs) to explore vents throughout the world, the Chinese government submitted plans to the International Seabed Authority (ISA) in May 2010 to mine the hydrothermal vents around an underwater ridge in the Indian Ocean near Madagascar. The selected vents lie at a depth more than 1,500 metres (5,000 feet) below the surface, and the intended harvest is mineral-rich ore.

ENVIRONMENTAL IMPACTS OF DEEP-SEA MINING

Despite the expected benefits derived from gathering what lies beneath the ocean floor, some environmentalists are concerned about deep-sea mining. At 2,000 metres there is little margin for error. As we've seen before, equipment failure, engineering miscalculations and unforeseen accidents can have devastating consequences. The fear is that without proper monitoring and responsible mining protocols, hydrothermal vents and surrounding ocean ecosystems may be damaged.

But because of the vents' remote locations, it's hard to say exactly what damage will be done. Some experts predict that removing a sizeable portion of the seafloor could cause a major disturbance. Deep-sea mining may release toxic plumes of sediment from mining machinery, degrading or killing the seabed's filter-feeding organisms vital to the vent food chain. Such plumes might also block out light at shallower depths, hindering the development of plankton, also vital to the food chain. Deep-sea mining could reopen naturally closed vents and release sulphur and methane compounds toxic to surrounding ecosystems. Some predict the mining could cause suboceanic landslides, while others fear the equipment will produce enough noise and vibration in the floor-to-surface water column to disrupt the lives of marine mammals that live there. As conservationist Charles Clover said, "The potential for conflict between commerce and conservation is huge."

On the other end of the controversy, some of the most ardent proponents of deep-sea mining are the scientists themselves. Some believe that if done responsibly the information and resources gleaned outweigh potential problems. Many scientists argue that hydrothermal



“The potential for conflict between commerce and conservation is huge.”

vent ecosystems do not appear to be fragile. For millennia they have withstood enormous natural impacts and are periodically decimated. Yet they rebuild within only a few years, proving great resilience.

THE DEBATE CONTINUES

While advocates and opponents argue the implications of exploration, at this point the greatest obstacle to deep-sea mining is cost, as a single operation can run into hundreds of millions of dollars per year. But as land-based mineral ores become increasingly scarce and the quest for new drugs escalates, there is no doubt the ocean floor will be targeted for mining. Although we can hope, it remains to be seen whether this technological treasure hunt will be undertaken with respect for environmental conservation and sustainability.

↑ The Alvin submersible vehicle on board the R/V Atlantis in preparation for hydrothermal vent exploration in 2000
Image courtesy Richard A. Lutz/Rutgers University

Exercises for Body and Brain

Boost your mental and physical power with complex aerobic exercises

Text by Jessica B. Adams, Ph.D., and Stephanie N. Del Tufo, B.A.
Photos by Stephen Frink



Exercise is a powerful tool to optimise brain function and your overall scuba performance. Scientists used to believe that adult neurons couldn't regenerate. Little did they know that aerobic exercises such as the ones described here encourage the development of new neurons. In fact, even people with dementia, a neuro-degenerative disorder, have shown a 34 percent decrease in cognitive degradation following cardiovascular exercise three times a week.

Complex aerobic exercise increases cognitive flexibility and interneuron communication. This is important for executive brain function, which allows the shift of attention and the ability to produce creative problem-solving strategies.

Open-water diving takes place in a dynamic environment. Improved cognitive flexibility may allow divers to recognise more quickly any changes in their environment and to come up with novel solutions to adapt to those changes. For a diver, this maximises dive efficiency by increasing the connections between memories of learning to dive, previous dive experiences and muscle memory. This efficiency allows a diver to respond to a challenging situation more quickly.

The following complex exercises should be completed in sequence with little rest in between. Your ultimate goal is to maintain an elevated heart rate for at least 30 minutes to achieve optimal cognitive and physical benefits. Start with 10 minutes, and gradually increase the duration as your exercise tolerance builds.

Many of these movements have multiple steps, so be patient with yourself. The sequences are designed to challenge your coordination, improving visual and motor integration.

Sequence:

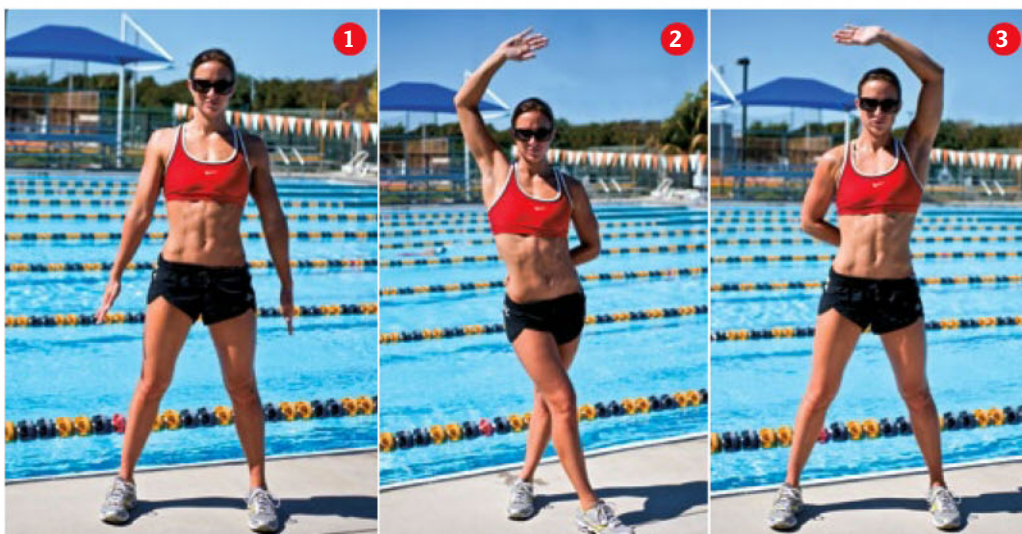
- **Overhead Cross Jacks (30 seconds)**
- **Lateral Squat with Cross (20 repetitions/side)**
- **Overhead Cross Jacks (30 seconds)**
- **Burpee to Side Plank (10 repetitions/side)**

OVERHEAD CROSS JACKS

This is similar to a traditional jumping jack, but arms go up only one at a time, and when legs come together, they criss-cross, alternating which foot is placed in front of the other. Notice that both the hands and feet cross the midline of the body while your arms are doing different movements bilaterally.

Form:

1. Start with hands at your sides.
2. Jump both feet apart, swinging one arm low behind your buttocks and one arm high above your head.
3. Jump both legs in, crossing one in front of the other. Reverse arm position.
4. Jump both legs out.
5. Continue for 30 seconds. Once you have mastered the movement, see how many repetitions you can complete in 30 seconds.

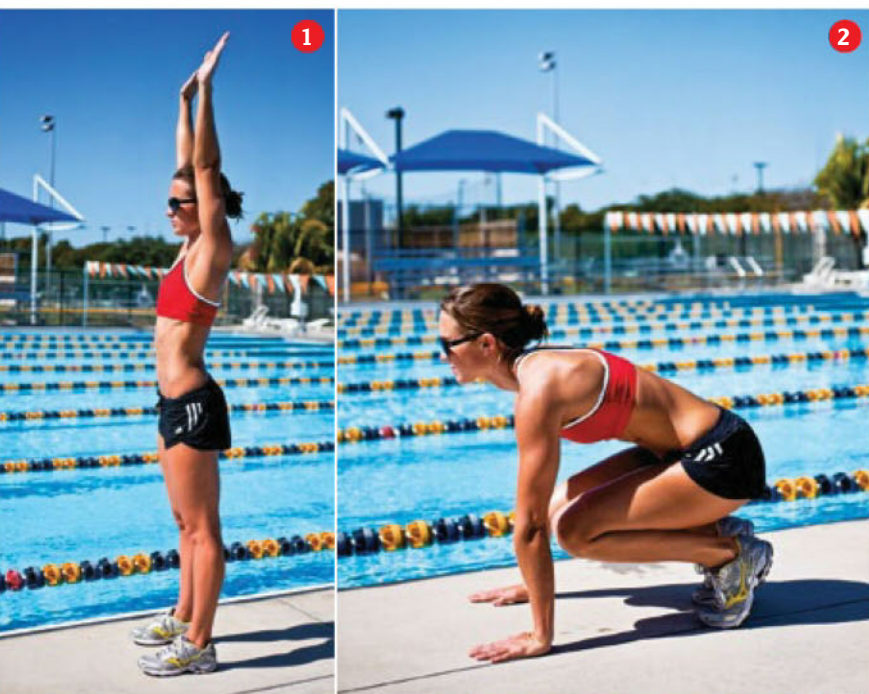
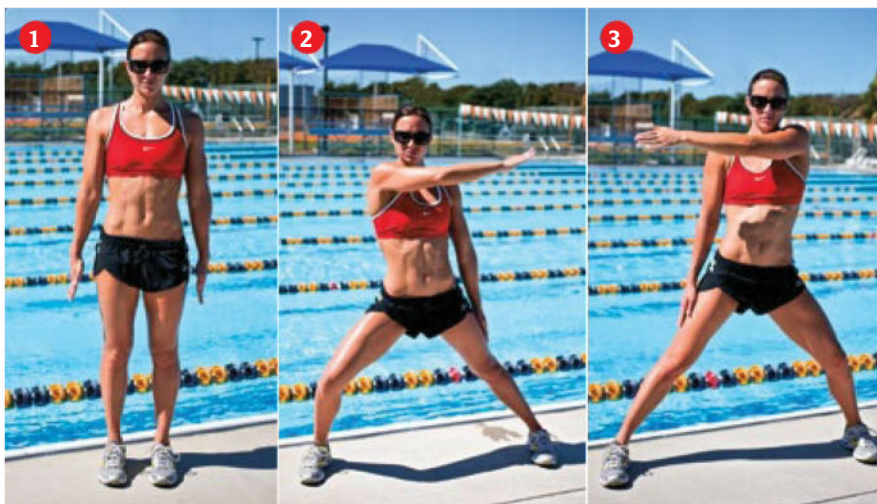


LATERAL SQUAT WITH CROSS

Sit back into the squat position, keeping your weight through your heels and eyes toward the sky. Try to get as deep into the squat as you feel comfortable. Your range of motion will naturally increase with each workout. Make sure you focus on form. Complete 20 repetitions to each side.

Form:

1. Start with your feet shoulder-width apart and arms straight at your sides.
2. Step laterally (to the side) as far as you can, and squat down as low as you can. Don't step or squat beyond what's comfortable.
3. Simultaneously, bring your arm across your chest. If you are squatting to the right, bring your right arm across your chest.
4. Return to starting position, and repeat on the opposite side.

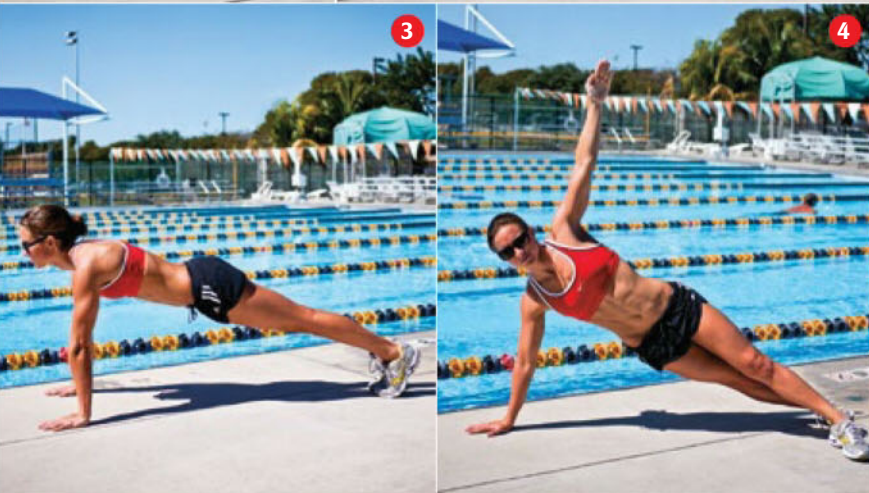


BURPEE TO SIDE PLANK

Try to hold each plank position for as long as you can while maintaining a straight body. Work up to holding each plank pose for 30 seconds. Complete 10 repetitions to each side.

Form:

1. Start standing with both arms extended above your head.
2. Squat down, placing your hands on the floor.
3. Step or jump your feet back until you are in plank position.
4. Transfer weight onto one hand in side plank position.
5. Transfer weight back to plank.
6. Jump feet in and stand up, raising arms overhead.
7. Repeat on opposite side.



Jessica Adams and Stephanie Del Tufo are a sibling team actively engaged in research on the body and brain, respectively.

Jessica is an assistant professor in the department of physical education at Kean University in Union, New Jersey. She is co-author of *Fit for Scuba*, a strength and conditioning handbook and a proud alumna of the DAN

internship programme. Jessica is also a health fitness specialist certified by the American College of Sports Medicine.

Stephanie is a technical research assistant in the department of brain and cognitive sciences at the Massachusetts Institute of Technology. She earned her B.A. in neuroscience at Smith College, Massachusetts.

Twenty Minutes Later, the Oxygen Ran Out

The importance of Oxygen First Aid Preparedness

By John Lippmann, Founder & Chairman, DAN Asia-Pacific

DAN Asia-Pacific's CEO, Chris Wachholz:

In my last *Alert Diver* editorial (Quarter 3, 2014), I raised the mighty challenge DAN Asia-Pacific faces in working to improve oxygen first aid preparedness within the vast Asia-Pacific region.

Oxygen First Aid Preparedness means having the right equipment, knowing how to use it and – very important in Asia-Pacific's very remote locations – having an adequate supply.

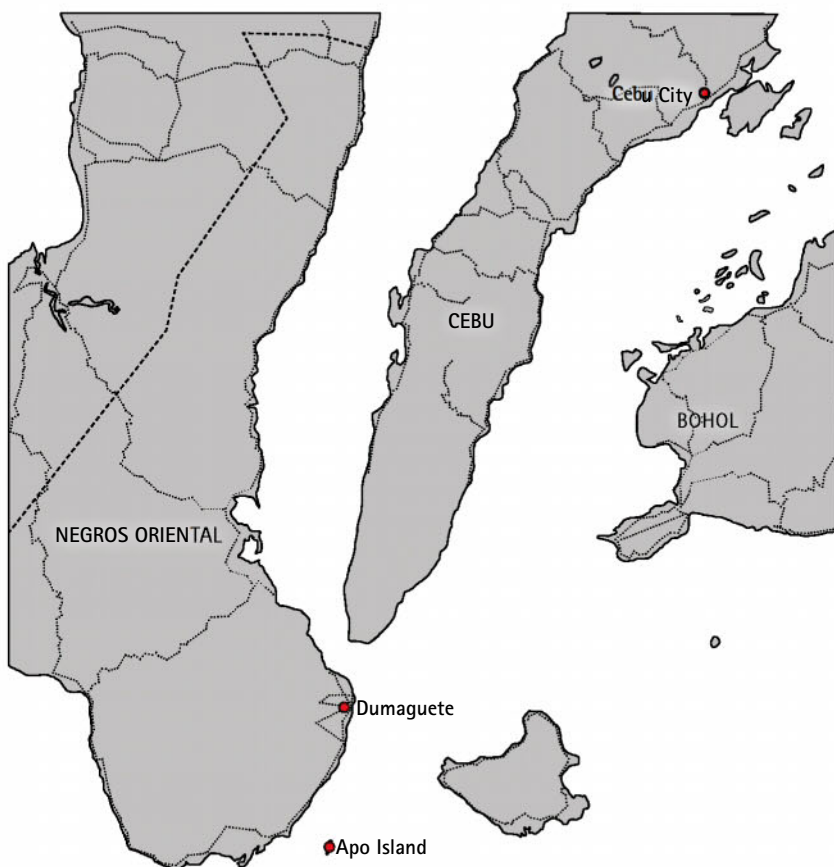
Today, more dive operators have oxygen (O₂) equipment and know how to use it, but too often they don't have enough oxygen. Having a quality DAN O₂ kit with a small cylinder is great for the initial emergency but transport often cannot be made for several hours or until the next morning. In these circumstances we have regularly had the diver breathe oxygen overnight, using a free-flow non-rebreather (NRB) mask, which is standard issue in all DAN oxygen kits.

The following recent diving incident took place on Apo Island in the Philippines. To set the scene, Apo is a small Island, 30 kilometres south of Dumaguete City. There is no chamber on Apo, nor on the mainland of Dumaguete. The nearest chamber is located in Cebu, which is 180 kilometres from Apo Island. Whilst this doesn't sound like a great distance, when the trip involves two boat rides and two car rides, the time it takes to cover this distance increases. However, it is the most efficient way to get an injured diver to treatment.

Here, John Lippmann outlines the full details of the incident and discusses the various issues pertaining to oxygen preparedness, and more.

CASE REPORT:

 Ash (not his real name) is a healthy, 39-year-old man who was diving in the Philippines. He had done a total of 80 lifetime dives with no history of any previous episode of decompression illness. On this day, he did dives to 24 metres and 27 metres, each of about an hour's duration and separated by a two-hour surface interval. He stayed well within the no-decompression limits of his dive computer on both dives and added safety stops as a precaution. Both dives were uneventful with no apparent problems. However, about two minutes after boarding the boat after the second dive he noticed some chest tightness, and pain in his lower back. This caused some anxiety as it was unexpected and happened quickly. His partner (Anne) noticed a blue blotchy rash on his back. A few minutes later, the back pain intensified and Ash developed pins and needles in both lower legs and feet. There was apparently no oxygen equipment available on the boat and he



went without for the 15-minute boat ride towards shore. Unloading the boat occurred in about two metres of water in some chop and, by this time, Ash was aware that he was losing all feeling in his legs and would soon be unable to use them so, being a confident swimmer, he jumped into the water and swam to shore. When he tried to stand on reaching shallow water, his legs were completely numb, so he needed to be helped to shore.

On arrival at the dive store, and at Anne's request, a staff member put Ash on oxygen. The dive store owner, an experienced instructor, didn't believe that Ash had DCI as, in his opinion, the symptoms had "come on too quickly". Fortunately, Anne called the DAN Diving Emergency Service (DES) hotline and spoke to a dive doctor who diagnosed likely DCI and advised immediate and continued oxygen first aid, diving medical assessment and likely recompression. The doctor then contacted DAN Asia-Pacific to inform us of the situation with one of our members. DAN Asia-Pacific in turn contacted the nearest appropriate chamber, as well as the dive operator who was looking after Ash.

In the interim, Ash was being provided with oxygen by means of a resuscitation mask with oxygen inlet. After about an hour of oxygen first aid (with an increased flow rate) Ash's back pain improved greatly. Although his legs remained tingling and weak and his feet were partly numb, he was now able to walk.

What happened next included:

- Ash breathed oxygen from a small cylinder while he walked across the island to board a dive boat to transport him to the main island.
- A large hospital-sized oxygen cylinder was loaded onto the boat to use during the crossing.
- A small cylinder was available for use during the subsequent car journey to where he would take a ferry to the next island (where the chamber is located).
- The large cylinder didn't fit into the car and the small one ran out during the car trip.
- Industrial grade oxygen was readily available on this island but it was difficult to get medical oxygen.
- A large medical oxygen cylinder was finally obtained and the small cylinder was refilled but, by this time, Ash had been without oxygen for around 45 minutes.
- The small cylinder ran out during the ferry trip and, as the staff were unable to connect the large cylinder, Ash was without oxygen for about 35 minutes of the almost hour-long ferry journey.



“The administration of as near as possible to 100 percent oxygen is the cornerstone of first aid for decompression illness.”

- On arrival, a waiting ambulance transported Ash at speed for another two to three hours to the chamber, breathing oxygen from the large cylinder which was able to be connected in the ambulance.
- When evaluated at the chamber (11 hours after surfacing), he was found to still have numbness, tingling and weakness in his legs.
- He was recompressed for almost five hours (US Navy Table 6) and was discharged after another two similar treatments.
- Fortunately, Ash has made a full recovery.

↑ Oxygen preparedness includes ensuring that staff are familiar with procedures for refilling oxygen cylinders and that there are enough units to allow a continuous supply until the patient reaches an adequate medical facility
Image © Stephen Frink

DISCUSSION

The administration of as near as possible to 100 percent oxygen is the cornerstone of first aid for decompression illness. There is good evidence that the provision of prompt and appropriate



oxygen first aid will likely reduce the number of required treatments and accelerate recovery from DCI. However, despite this being known for many, many years, and despite relevant education and training becoming more widespread, oxygen first aid is often not provided optimally. In our experience, this problem is greater in some developing countries where diving activity is increasing and where access to good diving medical facilities can be more difficult and delayed. This provides a challenge for DAN, the diving medical community, the diver training agencies and for the broader diving community.

“What may seem to be a short delay can sometimes affect the extent of recovery, or, in some instances, the chance of survival.”

One of the best ways to improve our systems is to learn from experience, and case studies, such as the one above, provide valuable insights. So, in the following paragraphs I'll discuss some of the lessons we can learn from Ash's experience.

There was no oxygen available on the boat

Oxygen should be available wherever diving is conducted. Even if a dive site may be only 15 to 20 minutes from a shore base, what may seem to be a short delay can sometimes affect the extent of recovery, or in some instances, the chance of survival, especially in the event of a cerebral arterial gas embolism (i.e., bubbles in

blood vessels supplying the brain). In reality, a fast return to shore is often delayed while waiting for other divers to surface.

The dive operator initially didn't believe that Ash had DCI

This is not uncommon. Although dive professionals are taught about the recognition and first aid for DCI and other diving accidents, this is relatively basic and most have little or no further and/or extensive diving medical knowledge or experience. For this reason, most dive professionals (and other divers) should never put themselves in the position of trying to diagnose any medical problem, such as possible DCI. A DAN-supported hotline is available, 24 hours a day, seven days a week for advice on a problem that has occurred after diving. In the event of a diver having symptoms post-diving, there should be little hesitation in seeking this advice. Failure to do so can delay proper management which could affect the diver's recovery, as well as create a potential problem for the operator.



↗ Returning to shore may be delayed while waiting for other divers to return to a boat. Having a supply of oxygen on board should be a prerequisite for any dive operator
Image © Stephen Frink

In this case, the dive operator's doubts didn't prevent Ash from receiving oxygen and this is how it should be. However, we have seen many cases where such doubts have delayed or reduced the required oxygen first aid.

Unsuitable oxygen delivery system

Despite not having oxygen on the boat, it was good that the operator had oxygen equipment available shortly afterwards. However, from reports we received, it appears that the equipment used could only deliver a relatively low concentration of oxygen. The resuscitation mask used (similar to the one shown in Figure 1), would likely have delivered around 40 to 60 percent inspired oxygen at flow rates of 8 to 15 litres per minute (lpm). It was reported that the flow rate was unknown and likely to be lower than 15 lpm so we can assume that Ash received a maximum of about 50 percent oxygen, far less than the optimal 100 percent. Such masks are primarily designed for resuscitation purposes and not to provide oxygen to a breathing person.

Some other low-concentration delivery devices that are sometimes used are shown in Figures 2 and 3. Again, these deliver relatively low concentrations of oxygen (often 30 to 50 percent) and, while good for many other medical conditions, are far from ideal for a victim of decompression illness as they allow a lot of air to be inhaled and so dilute the oxygen breathed by the diver.

Often the best delivery device for use with a conscious diver like Ash is a medical oxygen demand valve with a tight-sealing mask (Figure 4). Such a device is capable of providing about 80 to 100 percent inspired oxygen, depending mainly on the mask seal and operating condition of the valve. Some operators use a modified diving demand valve for this purpose but in this case it is important that the diver's nose is blocked (e.g., by a nose clip) to prevent air being sucked in with the oxygen.

A reasonable alternative to the demand valve is a non-rebreather mask with reservoir, ideally fitted with three one-way valves (Figure 5). With a good seal and a flow rate of 15 lpm, these can deliver up to 95 percent oxygen to a breathing diver. However, if the seal is poor, if one-way valves are missing or if the flow rate is lower, the delivered oxygen concentration will be significantly lower, perhaps 60 to 70 percent instead.

None of the delivery devices mentioned above (other than the resuscitation mask) is suitable for use with a non-breathing victim, so it is important that whatever oxygen unit is used can also provide this capability.

“The best delivery device for a conscious diver like Ash is a medical oxygen demand valve with a tight-sealing mask.”





“Suitable air evacuation options are not always available and it is essential for dive operators to have a clear plan in place.”

↑ Learn more about DAN AP's O₂ units and the most suitable unit for your needs. Select "DAN Products" at www.danap.org

There was an inadequate oxygen supply to cover the diver until appropriate medical care was available

You read above about the problems faced when trying to maintain oxygen administration while transporting Ash. It was great that the operator had a large cylinder on base and the determination and persistence of the dive staff to obtain more supply was admirable. However, it is obvious that there was a need for several smaller cylinders to cover the oxygen needs for transport to the chamber.

Another thing to consider is whether or not there was an alternative oxygen set and supply available to provide first aid to another diver who might have needed it while the main unit was being used by Ash, either on site, or while he was being transported. I am certainly familiar with some instances where no oxygen was available to treat a second diver as the only oxygen unit was being used elsewhere.

It was mentioned that despite it being very difficult to get more medical-grade oxygen, a supply of industrial-grade oxygen was available. Although the purity of the oxygen pumped into medical and industrial cylinders is identical, industrial cylinders are only 'topped-up' rather than completely emptied before being refilled. Therefore, there is a small chance that contaminants could have entered an empty industrial cylinder prior to filling and, for this reason, medical professionals and first aiders are wisely discouraged from routinely using industrial oxygen. However, with a diver with suspected DCI, if the alternative is no oxygen, industrial oxygen could be used as long as the equipment is compatible.

Lack of obvious emergency plan

One important point that Ash made was that it appeared to him that the dive operator did not have a clear emergency plan to deal with a diver, such as him, with DCI. He mentioned that they appeared to have no clear idea of how to readily get a diver to treatment, where the actual chamber was, the timings of the ferry and the amount of additional oxygen required for the journey.

Even if someone is a DAN Member or has alternative diving accident coverage, suitable air evacuation options are not always available and it is essential for dive operators to have a clear plan in place to cover such eventualities.

OXYGEN PREPAREDNESS: HOW YOU CAN HELP

DAN Asia-Pacific handles many diving accidents and, as mentioned before, it is surprising how often we encounter shortcomings in the oxygen first aid provided to the divers. As a result, we have launched an "Oxygen Awareness and Preparedness Programme" to redouble the already substantial education efforts in this area by DAN and some diver training organisations. It is essential for all dive professionals and a benefit for all divers to have a good understanding of oxygen first aid and the types of equipment that are suitable.

As a diver in the Asia-Pacific, your help is needed. Before you book a dive ask some questions to gauge whether the operator will be able to assist you in the event of a diving incident, for example:

1. Is there O₂ on all their boats?
2. Can the O₂ equipment give high concentration oxygen to a breathing and non-breathing diver?
3. How many hours O₂ supply do they have? Is it enough to get to appropriate medical care?
4. Is their staff trained in O₂ first aid?
5. Do they have an Emergency Plan?

More advice will follow in future issues of *Alert Diver*. 

Home: Covered ☒

Car: Covered ☒

Are You?



I was evacuated from Truk Lagoon to Guam, as the local Chamber was not ready to receive me. The evacuation itself cost \$60,000. The Chamber treatment and a 5-day hospital stay cost an extra \$10,000. Thankfully, as a DAN Member, 100% of my expenses were covered!

Joe, Singapore

Can You Afford Not to be a DAN Member?



www.danap.org/areyoucovered

Know Your Number

Make sure you can be reached in an emergency

By Chris Wachholz, CEO, DAN Asia-Pacific

Did you know that having a call-back phone number ready to give to DAN Emergency Staff in the event of a diving accident could be the most important part of your personal emergency plan?



One of the most frequent challenges faced by all DAN organisations is dealing with incorrect phone numbers. All it takes is for one digit in a call-back number to be wrong to prevent DAN from reaching a diver and delays to ensue. I have personally spent hours trying to

call a diver back when the number they provided was wrong.

Should you call a DAN Emergency Hotline you will quickly be asked for a number we can call you back on, just in case the call drops out or is disconnected, which happens often, as



phone connections in many parts of Asia, the Pacific, and the world, can be unreliable.

The examples below demonstrate how smooth or unnecessarily difficult case management can be, simply due to a phone number.

CASE 1: NUMBER KNOWN

The caller had an international calling plan and their cell/mobile phone worked where they were travelling. After the initial call to DAN was made, we were repeatedly and easily able to reach the diver so their condition could be assessed quickly, first aid advised and corrected, and transportation and referral to the chamber arranged and treatment provided. This all happened smoothly and in just a few hours, all because we were able to communicate quickly and easily.

CASE 2: WRONG NUMBER

The caller did not know how to be called in the country from where they were diving and when DAN was called they provided the calling sequence for calling their mobile phone from within their home country. As such, when the DAN Emergency Hotline staff member repeatedly attempted to call the diver, they were unsuccessful. Over 90 minutes ensued while many possible combinations of the wrong numbers were attempted. The caller had only stated they were in the Philippines but neglected to say the phone number they provided was from China or that it was a mobile number.

The DAN Emergency Hotline staff member consulted with a representative familiar with Chinese mobile numbers who suggested adding a “1” after the country code. Fortunately, this enabled DAN to connect with the diver but even then the connection was poor and the call dropped twice before a better connection was made. The chamber staff was contacted and authorisation given to treat the diver, but with the correct phone number provided this could have happened much, much faster.

The lesson? Making sure you are reachable on your cell phone is a simple but vital action divers can take to help themselves prepare for an emergency situation, and eliminate unnecessary delays. Fortunately, in the above case, the diver was already at the hospital and already receiving important emergency care. The situation becomes much more critical in an emergency situation far from medical care.



“Making sure you are reachable on your cell phone is a simple but vital action divers can take to prepare for an emergency situation.”

KNOW BEFORE YOU GO

- Check that you can make and receive international calls from the country you are travelling to.
- Remember to bring your phone charger and, if you have one, an extra battery.
- Have sufficient international credit for an emergency call to be made to DAN.
- Know how to make an international call from the country you are visiting.
- If your phone will not work (or to save more expensive toll charges) buy a local SIM card.
- Know how you can be called from outside that country: What is the international calling code for DAN to reach you? At the very least, when speaking to a DAN hotline operator, be sure to identify the location you are calling from (e.g., country and city).
- If your phone doesn't work, find out who on the liveboard or at the dive resort can make and receive international calls. Know this prior to your first dive.
- Have a back-up call-back number also ready in case your number or the primary number at the resort or liveboard does not work.

↑ If you have changed your SIM card for a local one, be sure you know how the number can be reached from overseas
Image © Stephen Frink

← Your emergency plan should include adequate preparation for being in regular contact with DAN and the local emergency services
Image © Lien-Yen Sun.

Be prepared: Knowing how DAN can reach you in the event of a diving accident could save your life or your limbs.



Defining Remote

Diving in far-flung locations means being prepared for challenging emergencies

By Scott Smith, EMT-P, DMT, and Brian Harper, W-EMT, DMT
Photos by Stephen Frink



Exotic, far-flung destinations hold pristine sights full of natural beauty. But the more remote the location, the more difficult it may be to manage an emergency should one occur. Understanding the specific challenges presented by remote environments provides an important benefit to adventurers. These challenges include time, environment, resources and independent decision-making.

TIME

In cities, towns and many resort areas, people are rarely required to spend more than a few

minutes with individuals who are seriously injured. Emergency medical technicians (EMTs), paramedics, nurses or doctors are available to take over care within minutes. In the time it takes to call the emergency services and have an ambulance dispatched and arrive on the scene, a patient can be in the hands of expert medical-care providers. In remote environments, however, travel companions of those who become ill or injured may find themselves forced to give care to the best of their ability for hours or even days.

This means wounds must be cleaned thoroughly to prevent infection, and splints, wraps or slings may need to be constructed to limit further injury to bones and muscles. Medication may have to be administered, and careful notes should be taken to give to professional caregivers when an evacuation can be conducted.

“It’s quite possible you’ll be called on to provide care in heavy weather, at night, or in extreme temperatures.”



When providing care over an extended period, there is more to it than just addressing patients' medical needs. Caregivers must also figure out how to help them stay nourished, hydrated, warm and able to relieve themselves. It isn't just training, planning and sound judgment that are helpful in extended-care situations; good bedside manner and a willingness to provide comfort and encouragement are important as well.

ENVIRONMENT

Hospitals, clinics and even ambulances offer climate control, shelter, light and other amenities that are not guaranteed in wilderness settings. Be prepared to care for injured travel companions in darkness, rain and high winds when you visit remote areas. Be ready to face the sun's relentless rays, lethargy-inducing heat or finger-numbing cold as you administer aid.

Since bad conditions can increase the potential for injury, it is quite possible you'll be called on to provide care in heavy weather, at night or in extreme temperatures. Evacuation to a higher level of medical care will not be necessary for every little annoyance, but be prepared for trips to the doctor for simple infections, and for other seemingly mundane problems to become day-long ordeals.

RESOURCES

When an ambulance arrives at the scene of an accident, it comes loaded with equipment designed to provide assistance and relief to the sick or hurt. When no ambulance is available, you're stuck with the gear aboard your boat or in your pack. This means spending time deciding what equipment to bring on a trip is time well spent. It's worth brainstorming a variety of scenarios to improve your chances of being prepared for the most likely and most serious situations you may face. It also means you may need to improvise important gear you don't have with you. Effective improvisation of equipment is an essential skill in wilderness medicine.

Even where medical care is available in rural or remote areas, the imaging equipment necessary to determine injury severity may not be. Basic casting materials, medications and expertise in reducing fractures, for example, may likewise be unavailable. It might be necessary for a group to splint an injury using whatever padding and rigid materials are available. When doing so, immobilise the injury without restricting circulation, and always use lots of padding.

Group members may even need to build a makeshift stretcher that can be dragged along the ground or carried to transport a patient to a clinic, hospital or airstrip. This is appropriate

except when a patient may have suffered a spinal injury. When a spinal injury cannot be ruled out, avoid moving the injured person unless there is an immediate threat to life or group members have the training to secure the patient to an available backboard – a device designed specifically for moving people who may have spinal injuries. Some equipment should not be improvised.

INDEPENDENT DECISION-MAKING

When a satellite phone isn't available and you cannot get a cell signal, you may find yourself having to make decisions without the guidance of a doctor, DAN medic or other expert. Good judgment and decision-making ability comes from training and experience. If you don't yet have these, travel with those who do. Ask your guides or tour operators about their training and emergency protocols before you book your trip. Some small resort islands have clinics in which physicians or nurses rotate through, but even in these cases the simplest diagnostic tests may not be available, and you may be faced with making significant decisions with less information than you would like to have.

When you are able to reach DAN, a doctor or local emergency services for consultation and evacuation, be ready to answer the questions they will ask. From the moment an accident occurs or symptoms of an illness first appear, designate a member of your group to keep notes on the evolving situation.

PREPARATION

Pack a headlamp and spare batteries in your first aid kit so you are prepared to help a travel companion at night. Extra water, sunscreen and insect repellent will be appreciated by all if a group is forced to stop moving in an exposed area because of an injury or acute illness. Although space and weight are often at a premium when traveling off the beaten track, a spare insulating layer is very valuable if someone gets hurt. When in doubt about items like rain jackets or wide-brimmed hats, bring them. Good exposure protection will help maximise the number of able-bodied caregivers while minimising the number of individuals who need help. Pack a notebook and pen so you can keep a record. A log of the patient's condition over time may be very valuable to medical professionals who take over patient care later.

Before you travel to a remote area, determine whether any immunisations are recommended for the area, and schedule those accordingly. Research the locations of the nearest clinics and hospitals, and find out the emergency number for an embassy or consulate for your country in the area where you're travelling. The websites of

◀ In remote locations, getting a patient to expert medical care can be challenging and time-consuming
Image © Stephen Frink



ask your physician about prescribing a backup supply you can keep in a separate place in case something happens to your medicine and it is not available at your destination.

Travellers with chronic health problems or uncommon medical conditions should consider carrying literature about their condition that they can share with a health-care provider. Some rare diseases that require treatment by specialists may be tricky to manage for practitioners who are unfamiliar with them. Ask your doctor to prepare instructions for emergency management of your condition so you are prepared for any complications that may occur. If there is a significant risk of an exacerbation of the condition, have an honest discussion with your physician about your medical fitness for a particular trip. It's possible that certain destinations might not be recommended due to their remoteness, but other, more popular, ones might be appropriate.

Consider getting training in wilderness first aid. With training, your preparation, decisions and judgment will improve. Since most people travel with their friends or family members, the wellbeing of your travel companions may be a powerful motivator for seeking training.

EMERGENCY RESPONSE

In the event of a serious illness or injury, contact local emergency services first if they are available and you have the means to reach them. Then call DAN Asia-Pacific on +61-8-8212-9242. DAN medical staff will monitor your care, answer questions and, if you are a DAN Member, arrange for you to be moved to a better hospital if necessary. This may mean returning to your home country or travelling to a more populous area near your location.

Evacuation takes time; there are many logistical elements to medical transport. Air ambulances are not generally able to take off at a moment's notice. They must work with local authorities to obtain landing permits, exit visas and other documentation before moving patients. Immigration must be cleared in the destination country. The process may be expedited in a medical emergency, but it still must take place. Sometimes the patient will need to be transported to a larger airstrip so an air ambulance may land and take off safely. Immediate flights are not always possible at night or outside normal hours of operation; some airports close and will not open after hours even for medical emergencies.

Consider the logistical challenges imposed by remote environments before you set out, and you will be better prepared to provide care and comfort to your fellow travellers.



“Consider the logistical challenges imposed by remote environments before you set out, and you will be better prepared.”

↑ Before venturing to the ends of the Earth, understand and prepare for the particular challenges that an injury or sudden illness will pose
Image © Stephen Frink

the Centers for Disease Control and Prevention, the World Health Organization and bodies such as the U.S. State Department are good sources of this information.

Sometimes travellers' primary-care physicians or dedicated travel clinics can provide precautionary antibiotics to treat simple infections should they occur. DAN does not support or discourage this; it is a decision to be made by the traveller and his or her physician. If you take any medication regularly,

I'm a DAN Member - Are You?

DAN helps thousands of divers every year. Not all calls for help are emergencies, but all these divers have one thing in common: They are thankful for the peace of mind their DAN Membership provides.

"I've dived for 10 years and completed 680 dives and I never thought I would have DCI, but I did. Thanks to DAN I was able to recover very well. I hope you are covered by DAN, so you too will have someone to count on in the very possible event of a scuba diving accident. DAN was of great help from the moment they received the call about my condition; their professionalism and care was so efficient and touching."

– Seung Hee, Korea

"I was evacuated from Truk Lagoon to Guam, as the local Chamber was not ready to receive me. The evacuation itself cost \$60,000. The Chamber treatment and 5 day hospital stay cost an extra \$10,000. Thankfully, as a DAN Member, 100% of my expenses were covered."

– Joe, Singapore

"I have been a dive professional for over 30 years. Diving is safe, but let's face it, accidents do happen sometimes and, when they do, I am glad DAN Asia-Pacific is there. I'm a DAN AP Member. You should be too."

– Col McKenzie, Director of SE Asian Operations, SSI Australasia

"My wife and I are eternally grateful for the amazing support we received from DAN. I had no idea how stressful an incident would be on my partner and me. Next time you think that you don't need DAN coverage, think twice!"

- Dirk, Australia

"As a dive operator in a remote part of the South Pacific, we're always happier if divers have DAN insurance. DAN Asia-Pacific is about so much more than medical insurance. It's about the comfort of knowing that there's expert medical advice at the other end of the phone, and who will move heaven and earth in pursuit of a good outcome. You just don't get that with standard travel insurance."

– Graeme Sanson, Dive Munda, Solomon Islands



www.danap.org/danhelpeadme

Underwater Navigation

Finding your way around just takes a little knowledge and experience

Text by Mike Ange
Photos by Stephen Frink



 Are you dependent upon your GPS, or do you rely on your innate sense of direction? Whichever method you use, you can count on the fact that neither is a reliable way to navigate the underwater environment.

Whether you are searching for that snapper hole on the reef or attempting to find the anchor line at the end of a dive, swimming in the right direction can be critically important for every diver at some point in his or her diving career. Additionally, good navigation skills have the potential to make virtually any dive more informative and enjoyable.

Underwater navigation seems to come easy for some divers and is harder for others. But any diver can master the art of underwater navigation by applying a small amount of background knowledge and obtaining some experience.

TYPES OF NAVIGATION

There are three types of navigation: Natural, instrument and practical. Natural navigation is what most divers try to practise on every dive by using underwater landmarks, geological features and other man-made or naturally occurring references on the bottom. Instrument, or compass, navigation entails following your compass closely throughout the course of your dive. Instrument navigation can make a dive tedious if the whole dive is spent focused on the compass.

Practical navigation is a hybrid, combining attributes of the other two types into something more useful than either one by itself. Using practical navigation, divers will take directional and distance cues from the terrain surrounding them and couple that with spot checks of the compass to formulate a complete mental picture of the site they are diving.

THE COMPASS

Instrument navigation is the most accurate type, if done properly. The primary navigational instrument of divers is the magnetic compass: a device consisting of a fluid-filled housing



containing a rotating disk called the compass card, which is visible under a clear lens. The card displays numeric markings that reflect the 360 degrees of a circle, and it contains a small magnet that seeks magnetic north – the northern extreme of the Earth's magnetic field. This magnet is positioned at an arrow, so the arrow always points north. Magnetic north is different from true north, and although this must be accounted for in long-distance navigation, it is not a concern for divers who operate within the small geographic areas of recreational dives.

The lens of a compass contains a red or black line called the lubber line, which allows the diver to select and maintain a direction of travel. On most compasses the lens is surrounded by a rotating bezel that is also marked with the degrees of a circle and has two, large index marks at 0° and 180°.

To use a compass most effectively, the diver should point the lubber line in the direction he intends to travel and read the number at the bottom of the compass. This number is the magnetic heading in which the diver will travel. The compass must be held level, since tilting it will cause the card to hit the compass' sides, preventing it from turning freely. The compass must also be pointed directly forward, in a straight line between the diver and his destination. Care must be taken to ensure that no metal objects are near the compass, as these can attract the north-seeking arrow, skewing the compass' reading.

USING THE BEZEL

While watching the small lens at the base of the compass and ensuring the desired numerical heading stays in the window, the diver should swim straight in the direction the compass is pointing. This is fairly hard; another, potentially easier, method is to use the index marks on the bezel to establish a quick reference. This is done by pointing the compass in the direction of travel, then rotating the bezel until its 0° index mark is lined up directly over the north-seeking arrow on the compass card. Now the diver can swim along in the proper direction and periodically check to ensure the north-seeking arrow is still aligned with the index mark. This quick reference method is generally much easier than trying to hold the compass at eye level to sight the heading while keeping the compass level and swimming in the direction it is pointing.

The bezel can also be used to quickly and easily plot a return course. If the diver simply turns his body until the north-seeking arrow lines up with the bezel's other index mark (the 180° mark), he will turn 180 degrees, facing in exactly the opposite direction in which he was swimming. It is important that the diver rotates his whole body and not the bezel or the compass. Of course, it's also possible to set a course in the opposite direction by calculating a new heading: Add 180° to the original heading if it is less than 180°, or subtract 180° if the original heading is equal to or greater than 180°.

↑ Compass position is important; wrist-mounted models are designed to be used with the arm bent 90 degrees

← Easily recognisable underwater features make great navigational aids

JUDGING DISTANCE

Accurate navigation also relies on the ability to correctly judge distance. The best way to do this is to time your swimming pace or count your fin cycles. A single fin cycle is completed every time the left foot kicks downward. Determine how many cycles it takes you to swim a fixed distance such as 30 metres (100 feet). Use a line that is precisely 30 metres in length and lay it straight along the bottom. Swim the length of the line using your normal swim pace and count each fin cycle. Repeat the swim four or five times and average the different counts. Note that your pace at depth is likely different from your pace on the surface.



↑ Digital compasses use a magnetometer to detect the Earth's magnetic field

PRACTISE, PRACTISE

You need lots of practice to become a good compass navigator. Dry land practice is better than nothing, but to really master the art of underwater navigation you need to go diving, preferably in an area with minimal current. Practise choosing a point on the surface and trying to navigate to that point underwater. Once you have mastered that, try swimming back to where you started without surfacing. As a rule of thumb, a good navigator can swim 100 metres out and 100 metres back, and arrive within five metres of where he started.

When you are ready for the big leagues, try swimming right-hand squares: Pick a heading and swim 30 metres, add 90° to the heading and swim 30 metres more in the new direction. Repeat this process twice more, and you should arrive back where you started. If you get a number higher than 360° at any point in your calculations, simply subtract 360° to get the heading you should use. To complete a left square, use the same procedure, but subtract 90° at each turn. If you really want to go for mastery, try swimming triangles by adding or subtracting 120° at each turn. Although you

will probably never enjoy doing every dive while watching nothing but your compass, these skills provide an excellent foundation for practical navigation.

PRACTICAL NAVIGATION

As divers, our primary navigational goals are finding some special point of interest during the dive and finding the boat or exit point at the end of the dive. Points of interest are easy because you can navigate directly to them if you know where they are and you have good instrument navigation skills.

Finding the exit point, however, can be quite difficult, even for experienced divers. Since most of us usually exit the water at the same point we entered, it is a good habit to identify a prominent bottom feature near you as soon as you descend. Then look for some of the natural navigational clues that are present at nearly every dive site. Sites near beaches, for example, will typically have ripples in the sand that are parallel to the shoreline. On sites where there is a predominant direction of current flow, there are usually depressions in the sand up current of solid objects and mounds of sand down current. Cues such as these can keep you swimming in the right general direction and help bring you back to where you started. For example, to swim out and back perpendicular to the beach, you only need to swim perpendicular to those ripples in the sand.

Reef lines, debris fields from wrecks and other physical structures can also be used to navigate, but they should be used with caution. These features do not always proceed in uniform directions, and if there are multiple structures, it is easy to get off course. However, if you note your initial direction of travel with your compass and note the time, you will be able to use your compass in addition to these physical cues to help get you back to your starting point. If you start swimming north, and after five minutes you turn 90° to the left at the huge brain coral and then swim another seven minutes, you can return to the boat by reversing your direction, swimming about six or seven minutes and looking for the brain coral where you will turn 90° to the right and swim five minutes back to the boat.

Just as diving experience teaches us to enjoy being underwater without fixating on our gauges, navigation experience teaches us to find our way around without keeping our eyes permanently glued to our compasses. By spot-checking the compass when you make your usual gas, depth and time checks, you will look like an expert by arriving back at the boat every time without the hazards of surfacing repeatedly to see where you are.

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Tuna: Super Fish

What's the first thing that comes to mind when you hear the word "tuna"?

By Matt Dozier



Is it bland, pinkish sandwich filling? Crimson slivers of velvety sashimi? Or perhaps a cartoon fish with a hat, glasses and a Brooklyn accent? If so, don't worry – you are not alone. Decades of seafood marketing and cultural perception are at work here. But after years of being treated like the “chicken of the sea”, it's about time tuna got the respect they deserve.

ATHLETES OF THE SEA

Let's clarify one thing up front: Tuna are not ordinary fish. They are athletic freaks of Nature, built for raw power, speed and endurance. They can withstand intense cold, dive to crushing depths and swim at speeds approaching 80 kilometres per hour. The largest species can grow to staggering dimensions: Sometimes three metres (10 feet) or more in length. The world-record Atlantic bluefin tuna, reeled in off Nova Scotia in 1979, weighed 1,496 pounds (679 kilograms) and ranks high on the list of the biggest fish ever caught.

“They are the pinnacle of bony fish evolution – they're the ‘super fish,’” says Barbara Block, a marine biologist at Stanford University, who is one of the world's leading experts on bluefin tuna. Block and her team

have tagged and tracked more than 2,000 Atlantic and Pacific bluefin during her career. Their research has revealed much about the epic migrations undertaken by these extraordinary fish, such as the Pacific bluefin that swam from California to Japan and back – more than 16,000 kilometres (10,000 miles) – in the span of just five months in 2003.

Similar to lions and wolves, tuna are apex predators that travel long distances in search of prey, tend to hunt in groups (schools), and play a key role in regulating the ocean food web. While it may seem strange to compare the main ingredients in Fancy Feast with such iconic land mammals, there's more truth in the comparison than you might suspect.

MEET THE THUNNINI TRIBE

So what exactly makes a tuna a tuna? Taxonomically speaking, tunas are predatory ocean-going fish belonging to a “tribe” called Thunnini, a subgroup of the mackerel family (Scombridae). The tribe encompasses the eight “true tunas” of the genus *Thunnus* – albacore, bigeye, longtail, yellowfin, blackfin and three species of bluefin – and seven other tuna species including skipjack, slender and little tunny.

All tunas, from the smaller bullet and frigate species to the giant bluefin, have streamlined, spindle-shaped bodies with a crescent-shaped tail fin, two dorsal fins, pectoral fins that can be tucked in for high-speed swimming and triangular “finlets” running along the upper and lower sides of the tail. Skin colouration varies from species to species but generally fades from metallic blue on top to silvery-white underneath, often with a splash of yellow accents.

Peeking under the hood, we find one of the most impressive pieces of biological machinery in the entire ocean. “When you look at a tuna, you're looking at an animal that's built for very, very high performance,” says Randy Kochevar, a marine biologist who works with Barbara Block at Stanford University's Hopkins Marine Station.

Indeed, every aspect of tuna physiology seems to push the limits of what's physically possible, from ultra-high-efficiency gills to a massive heart that can beat up to 200 times per minute. What makes these animals truly special

↓ Warm-blooded apex predators that never stop swimming, tuna play a key role in regulating the ocean food web. They are “the pinnacle of bony fish evolution”
Image © Anotinio Busiello



is not just their size, speed or strength but their unique evolutionary adaptations – honed over hundreds of millions of years – that make such incredible performance possible.

JUST KEEP SWIMMING – OR ELSE

The name *Thunnus* comes from the ancient Greek for “to dart” or “to rush” – an apt descriptor for these efficient, powerful swimmers capable of tremendous bursts of acceleration. That power comes at a price though. With high oxygen demands and a muscular physique that’s denser than seawater, a tuna can never stop swimming during its lifetime. Tuna require five to ten times greater flow of water over their gills than most fishes, which they achieve by swimming with their mouths perpetually open, which is known as “ram ventilation”. They fly through the water like fighter jets, their lack of buoyancy offset by the lift generated by their pectoral fins. And, like an aircraft, if a tuna stops producing forward thrust, it will sink like a stone.

To keep themselves in perpetual forward motion, tuna have evolved a compact swimming style consisting of short, powerful strokes of the tail with very little head movement. Bundles of deep red, oxygen-burning “slow-twitch” muscle running along the core of the fish enable them to sustain this unique form of locomotion over vast distances.

THE “WONDERFUL NET”

All the constant swimming tuna are forced to do generates a lot of excess heat. For most fish, that energy would be lost, dissipated quickly into the colder surrounding seawater. But, as we’ve established, tuna are not “most fish”. One of their remarkable evolutionary adaptations is the *rete mirabile* (Latin for “wonderful net”), a network of blood vessels that allows them to retain body heat and use it to warm their muscles, brain and eyes above the ambient ocean temperature. Members of the genus *Thunnus* can even heat their stomachs to aid digestion after swallowing a meal of ocean-chilled seafood.

That’s right – tuna are endothermic, or “warm-blooded”, like humans. No other bony fish can claim that distinction. While their cold-blooded cousins are generally limited to a narrow range of temperatures, tuna can move freely around the globe through the dark depths and the sunlit shallows, the sweltering tropics and the frigid higher latitudes.

Different species inhabit various regions around the globe, with some favouring tropical latitudes (yellowfin, skipjack), while others prefer cooler regions (albacore, Atlantic bluefin,



Pacific bluefin, southern bluefin). Bigeye in particular are champion divers, known to travel to depths of 1,000 metres (3,300 feet) or more in pursuit of food, making roller-coaster descents and ascents that would make a divemaster blanch.

A WANDERING LIFE

Tuna don’t turn into these hulking, supercharged speed demons overnight. Almost all tuna species spawn in warm tropical regions, where their larvae start life floating with the currents and dining on zooplankton until they begin to resemble miniature versions of their parents.

They continue to grow rapidly as juveniles, shifting their focus to new prey as they get larger. Tuna are opportunistic feeders and will happily consume a wide variety of prey over the course of their lives depending on their age, location and season. A highly abridged list of tuna prey includes crustaceans, squid and countless small fish species such as anchovies, sardines, menhaden, hake and mackerel.

Groups of tuna will often attack bait balls – huge, swirling schools of smaller fish – sometimes working in concert with other predators such as dolphins and seabirds as they drive their prey into ever-tighter spaces. Think of it as an all-you-can-eat sushi buffet, except in this case it’s the sushi that’s stuffing its face.

As they approach adulthood, the life history varies dramatically among tuna species (and sometimes even within species). Some tunas

↑ Humans’ insatiable appetite for tuna has put the future of some species in question
Image © Antonio Busiello



↑ Research and better management strategies are needed to produce tuna to satisfy consumer demand without wiping out wild populations
Image courtesy of Photomick/iStock Photo

stick closer to the coast, while others prefer deeper waters. Some never stray far from where they were born. Atlantic bluefin born in the Gulf of Mexico regularly migrate thousands of kilometres to the Mediterranean Sea, only to return to their birthplace to spawn many years later. “When you think about how they start their lives and are swept very quickly into the open ocean, the fact that they find their way back is truly remarkable,” says David Secor, a tuna biologist with the University of Maryland Center for Environmental Science.

Most tunas reach sexual maturity between two and five years of age, with the exception of the bluefin species, which can take anywhere from eight to 15 years to begin spawning. This topic has received considerable attention in recent years in light of widespread concern over the sustainability of tuna fisheries – or lack thereof – and the impact of overfishing on tuna populations around the globe.

FEEDING FRENZY

Humans have been catching and eating tuna for thousands of years. In the Mediterranean Sea the earliest evidence of bluefin tuna fishing

has been estimated at roughly 7,000 BC, with large-scale trap fishing developed by the Phoenicians around 2,000 BC. “Tuna built a lot of civilisations around the globe,” says Barbara Block. “It’s only recent generations that have begun to treat it like a commodity.”

Within the past 100 years or so, our craving for tuna in its many forms has ballooned into a full-blown addiction. Canned tuna, which debuted in the U.S. in 1903, succeeded in turning these proud fish into a bulk commodity that for decades reigned as the most popular seafood in America.

Then there’s the global market for bluefin meat, which is prized in sushi restaurants around the world, especially in Japan, where most top-quality bluefin ends up. Sold under names such as *otora* and *hon maguro*, the rich, fatty flesh ranges in hue from soft pink to deep red, looking more like filet mignon than Filet-O-Fish. Bluefin can fetch astronomical prices at Tokyo fish markets. A 222-kilogram (489-pound) specimen sold for a mind-boggling US\$1.78 million at auction in January 2013 – more than US\$8,000 per kilogram.

This gourmet feeding frenzy has been bad news for the future of bluefin populations, which continue to be overfished despite numerous scientific reports from academic institutions and conservation groups around the world warning that they are on the brink of collapse.

BACK FROM THE BRINK?

There are some signs, however, that tuna’s fortunes could be changing for the better. Barbara Block says she is encouraged by recent efforts to influence governments and consumers to take pressure off the most heavily overfished species such as Atlantic bluefin, which by most estimates has declined by more than 70 percent across all populations since 1970. “I think the tide is changing quickly,” she says. “What we need to do is figure out how to produce the tuna that the world needs without depleting wild populations.”

Tuna aquaculture, or “ranching”, certainly has potential in that regard, although critics say current practices do little to alleviate overfishing and even create a greater burden on tuna stocks. Block says she is hopeful that will change as the science and management continue to improve.

For now, though, conservation-minded consumers will want to steer clear of bluefin. And the next time you find yourself scarfing down a spicy tuna roll (almost certainly yellowfin or bigeye) or a tuna fish sandwich (albacore or skipjack), spare a moment to think about all the things that make these fish so amazing.

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Get Wet, Dive Dry

Understanding the basics of drysuit technology

Text by Michael Menduno



Drysuits have long been standard dress for many technical divers, underwater photographers, instructors and other professionals who spend a lot of time underwater. It's not surprising then that with longer dive times arising from the use of nitrox and larger capacity cylinders as well as a greater awareness of the available options, recreational divers are increasingly choosing to dive dry, even in relatively warm water.

BASICS

Drysuits are based on the idea of an inflatable, watertight shell, which creates a dry envelope around a diver's body, combined with insulating undergarments. This two-part system, invented by British engineer Augustus Siebe in 1837, effectively limits heat loss, which is 25 times greater in water than on land. The insulating benefits of the system are especially useful at deeper depths, where compression of the tiny air pockets in neoprene wetsuits diminishes their insulating ability. Drysuits are easily adapted to a wide range of water temperatures; all you have to do is choose the appropriate thermal undergarments for the water temperature and your anticipated level of exertion.

Another benefit drysuits offer is improved ability to maintain neutral buoyancy throughout the water column. The diver can add gas to the suit using a manual inflator valve, and excess gas is purged through an exhaust valve positioned near the top of the suit. A drysuit should never be used as a buoyancy device in place of a BCD; divers should add just enough gas to the suit to avoid suit squeeze and make sure to vent excess gas when ascending. Compared to wetsuits, they generally require more weight to submerge, depending on the undergarments worn. Like other diving technologies, drysuits require both training and practice; most training agencies offer a drysuit course.

THE SHELL GAME

Broadly speaking, there are two types of drysuits: shell suits (also known as membrane suits) and neoprene suits. Shell suits typically consist of one or more layers of durable fabric such as polyurethane-coated nylons,

↑ These remarkable garments allow divers to comfortably enjoy places and seasons formerly inaccessible to them
Image © Stephen Frink

vulcanised rubber or crushed neoprene (neoprene without air cells). Trilaminate shells are a popular option; these consist of three layers of material such as nylon, butyl rubber and another layer of nylon bonded together to form a tough waterproof barrier.

Shell suits, particularly those made with trilaminate, tend to be lightweight and flexible and can therefore be worn all day without physically exhausting the diver. They are easier to don than neoprene suits and dry faster. In addition, because the shell itself offers minimal thermal protection, the suit is ideal for diving over a broad range of water temperatures, from near freezing up to 20 or 23 degrees, depending on the undergarments used. The trilaminate shell suit is probably the most popular among technical divers, though many wreck divers prefer the heavier-duty crushed neoprene.

FOAM NEOPRENE

Constructed of the same material as wetsuits, older-style foam neoprene drysuits are typically cut more snugly to reduce drag. Because the warmth comes primarily from the neoprene itself, these suits usually require fewer or lighter undergarments. This also means they are best suited to diving in colder water. They require more weight than shell suits and, like wetsuits, suffer from diminished insulation at deeper depths. Many commercial divers, who tend to work at fixed depths, prefer these suits because they can take a lot of abuse. They are also used in specific applications like recreational dive instruction and dry caving where sumps must be negotiated. They are usually less expensive than shell suits, making them an attractive choice for some beginning drysuit divers.

SELECTING SUITABLE OPTIONS

Because drysuits are typically made of tough fabrics and are roomy, which means less stretching and straining of the material, they can last a long time. They come in a variety of styles including self-donning (with the zipper across the chest from shoulder to hip), telescoping torso, and shoulder entry or back donning (with the zipper across the back). The current trend is toward self-donning suits, which allow greater range of motion, though many divers still find a buddy's help makes suiting up much easier.

Drysuits' watertight neck and wrist seals come in two varieties: latex and neoprene. Latex, which can stretch up to 400 percent, generally creates a better seal and is easier to put on and take off. They require more careful handling, though, and have a shorter life expectancy, requiring replacement when they



◀ With a little extra training, divers can take advantage of the added thermal protection offered by drysuits
Image © Stephen Frink

wear out. Neoprene seals, which usually include a Lycra lining, expand by only about 100 percent and are harder to get on and off, but they hold up longer and can take more abuse. Latex seems to be the preferred choice for most tech divers. One of the latest innovations in drysuits is Diving Unlimited International's (DUI) patented "zip seals", which snap into place rather than being glued, allowing them to be changed out in the field if necessary.

A feature that makes a nice addition for cold-water diving is a warm neck collar overlay, and some divers wear a silk scarf underneath. Another option for really cold water is dry gloves, which are worn at the cost of some minor dexterity loss. A word to the wise: Warm, dry hands are divine. Several additional features to consider are bellows pockets (with Velcro flaps and enclosed bungee cords for securing items), crotch pads and kneepads.

If you plan to stay hydrated, which is critical for safe diving, you will need a way to relieve yourself while wearing your drysuit. If diapers aren't your style, the P-valve system consists of a balanced dump valve, mounted on the suit near the inside of the thigh, which is attached to a length of rubber tubing. Men attach the tube to a self-adhesive condom catheter, and they're good to go. Women wear a self-adhesive external catheter cup, such as the She-P.

Suitable undergarments are typically made from synthetic fleeces like Polartec or Thinsulate. Be sure to select undergarments designed for the water temperature(s) you plan to dive in. Layering is often a good choice. Also consider choosing materials that maintain their thermal properties when wet in case of a suit flood or serious leak. Drysuits are rarely 100 percent dry. Despite modern materials and advanced designs, they can leak, and moisture and perspiration can accumulate. Sometimes getting wet means getting wet. Ultimately, however, the thermal benefits of drysuits are unmatched. Whether you're trying to extend your dive times or your dive season, diving dry might just be the way to go.

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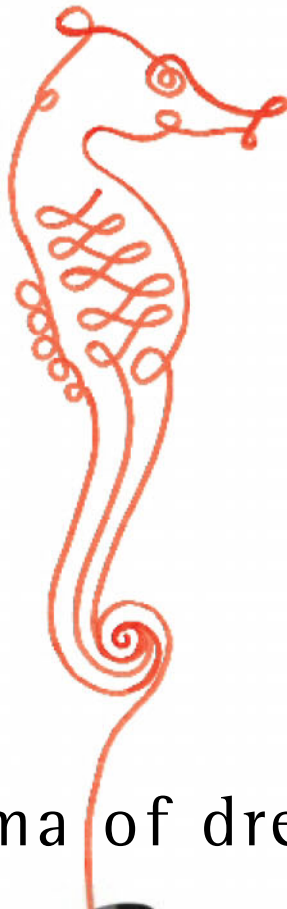
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